Instruction Manual

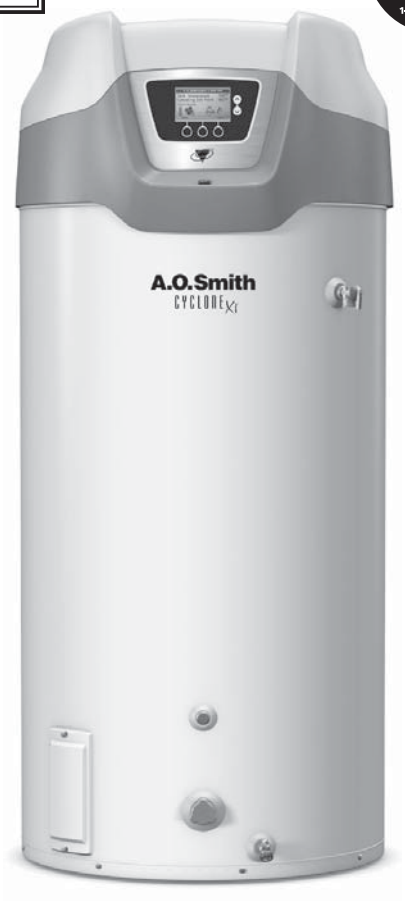
COMMERCIAL GAS WATER HEATERS

500 Tennessee Waltz Parkway
Ashland City, TN 37015

ANSI / NSF 5

MODELS BTH-120/150/199/250
SERIES 100 & 101

INSTALLATION - OPERATION - SERVICE - MAINTENANCE - LIMITED WARRANTY



WARNING: If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

— **Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**

— **WHAT TO DO IF YOU SMELL GAS:**

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call the fire department.**

— **Installation and service must be performed by a qualified installer, service agency or the gas supplier.**

Thank you for buying this energy efficient water heater. We appreciate your confidence in our products.

⚠ WARNING

Read and understand this instruction manual and the safety messages herein before installing, operating or servicing this water heater.

Failure to follow these instructions and safety messages could result in death or serious injury.

This manual must remain with the water heater.

PLACE THESE INSTRUCTIONS ADJACENT TO HEATER AND NOTIFY OWNER TO KEEP FOR FUTURE REFERENCE.

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SAFE INSTALLATION, USE AND SERVICE

The proper installation, use and servicing of this water heater is extremely important to your safety and the safety of others.

Many safety-related messages and instructions have been provided in this manual and on your own water heater to warn you and others of a potential injury hazard. Read and obey all safety messages and instructions throughout this manual. It is very important that the meaning of each safety message is understood by you and others who install, use, or service this water heater.

	This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER	DANGER indicates an imminently hazardous situation which, if not avoided, will result in injury or death.
WARNING	WARNING indicates a potentially hazardous situation which, if not avoided, could result in injury or death.
CAUTION	CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.
CAUTION	CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, could result in property damage.

All safety messages will generally tell you about the type of hazard, what can happen if you do not follow the safety message, and how to avoid the risk of injury.

The California Safe Drinking Water and Toxic Enforcement Act requires the Governor of California to publish a list of substances known to the State of California to cause cancer, birth defects, or other reproductive harm, and requires businesses to warn of potential exposure to such substances.

This product contains a chemical known to the State of California to cause cancer, birth defects, or other reproductive harm. This appliance can cause low level exposure to some of the substances listed in the Act.

APPROVALS

ASME CRN

ANSI / NSF 5

NOTE: ASME construction is optional on the water heaters covered in this manual.

GENERAL SAFETY INFORMATION

PRECAUTIONS

DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. Immediately call a qualified service agency to inspect the appliance and to make a determination on what steps should be taken next.

If the unit is exposed to the following, do not operate heater until all corrective steps have been made by a qualified service agency.

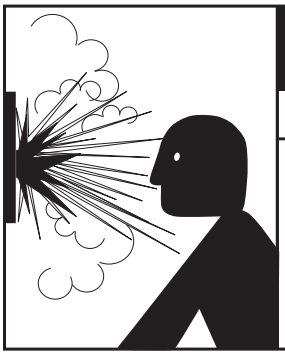
1. External fire.
2. Damage.
3. Firing without water.

GROUNDING INSTRUCTIONS

This water heater must be grounded in accordance with the National Electrical Code and/or local codes. These must be followed in all cases. Failure to ground this water heater properly may also cause erratic control system operation.

This water heater must be connected to a grounded metal, permanent wiring system; or an equipment grounding conductor must be run with the circuit conductors and connected to the equipment grounding terminal or lead on the water heater.

HYDROGEN GAS FLAMMABLE



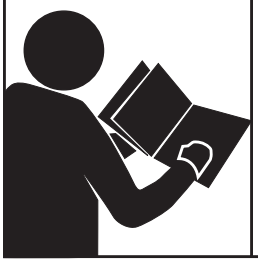
⚠WARNING

Explosion Hazard

- Flammable hydrogen gases may be present.
- Keep all ignition sources away from faucet when turning on hot water.

Hydrogen gas can be produced in a hot water system served by this appliance that has not been used for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable. To reduce the risk of injury under these conditions, it is recommended that a hot water faucet served by this appliance be opened for several minutes before using any electrical appliance connected to the hot water system. If hydrogen is present there will probably be an unusual sound such as air escaping through the pipe as the water begins to flow. THERE SHOULD BE NO SMOKING OR OPEN FLAME NEAR THE FAUCET AT THE TIME IT IS OPEN.

Verify the power to the water heater is turned off before performing any service procedures.

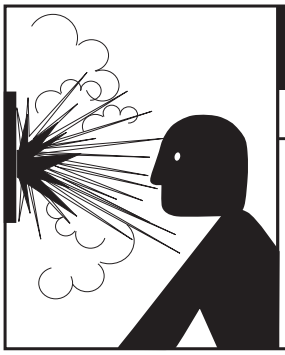


⚠WARNING

Read and understand this instruction manual and the safety messages herein before installing, operating or servicing this water heater.

Failure to follow these instructions and safety messages could result in death or serious injury.

This manual must remain with the water heater.

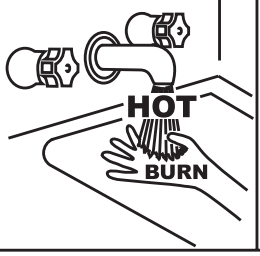


⚠WARNING

Explosion Hazard

- Overheated water can cause water tank explosion.
- Properly sized temperature and pressure relief valve must be installed in the opening provided.

⚠DANGER



Water temperature over 125°F (52°C) can cause severe burns instantly resulting in severe injury or death.

Children, the elderly and the physically or mentally disabled are at highest risk for scald injury.

Feel water before bathing or showering.

Temperature limiting devices such as mixing valves must be installed when required by codes and to ensure safe temperatures at fixtures.

CAUTION

Improper installation, use and service may result in property damage.

- Do not operate water heater if flood damaged.
- Inspect and anode rods regularly, replace if damaged.
- Install in location with drainage.
- Fill tank with water before operation.
- Properly sized thermal expansion tanks are required on all closed water systems.

Refer to this manual for installation and service.

GENERAL SAFETY INFORMATION

⚠WARNING

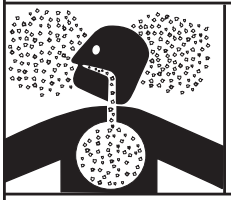
Fire or Explosion Hazard

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- Avoid all ignition sources if you smell gas.
- Do not expose water heater controls to excessive gas pressure.
- Use only the gas shown on the water heater rating label.
- Maintain required clearances to combustibles.
- Keep ignition sources away from faucets after extended periods of non-use.

Read instruction manual before installing, using or servicing water heater.

⚠WARNING

Breathing Hazard - Carbon Monoxide Gas



- Do not obstruct water heater air intake with insulating blanket.
- Gas and carbon monoxide detectors are available.
- Install water heater in accordance with the instruction manual.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

CAUTION

Property Damage Hazard

- All water heaters eventually leak.
- Do not install without adequate drainage.

⚠WARNING

Electrical Shock Hazard

- Turn off power to the water heater before performing any service.
- Label all wires prior to disconnecting when performing service. Wiring errors can cause improper and dangerous operation.
- Verify proper operation after servicing.
- Failure to follow these instructions can result in personal injury or death.

⚠WARNING

Fire Hazard

For continued protection against risk of fire:

- Do not install water heater on carpeted floor.
- Do not operate water heater if flood damaged.

⚠WARNING

Fire and Explosion Hazard

- Use joint compound or Teflon tape compatible with propane gas.
- Leak test before placing the water heater in operation.
- Disconnect gas piping and main gas shutoff valve before leak testing.
- Install sediment trap in accordance with NFPA 54.

⚠WARNING

Fire and Explosion Hazard

- Do not use water heater with any gas other than the gas shown on the rating label.
- Excessive gas pressure to gas valve can cause serious injury or death.
- Turn off gas lines during installation.
- Contact a qualified installer or service agency for installation and service.

⚠WARNING

Jumping out control circuits or components can result in property damage, personal injury or death.

- Service should only be performed by a qualified service agent using proper test equipment.
- Altering the water heater controls and/or wiring in any way could result in permanent damage to the controls or water heater and is not covered under the limited warranty.
- Altering the water heater controls and/or wiring in any way could result in altering the ignition sequence allowing gas to flow to the main burner before the hot surface igniter is at ignition temperature causing delayed ignition which can cause a fire or explosion.

Any bypass or alteration of the water heater controls and/or wiring will result in voiding the appliance warranty.

INTRODUCTION

Thank You for purchasing this water heater. Properly installed and maintained, it should give you years of trouble free service.

ABBREVIATIONS USED

Abbreviations found in this Instruction Manual include :

- ANSI - American National Standards Institute
- ASME - American Society of Mechanical Engineers
- GAMA - Gas Appliance Manufacturer's Association
- NEC - National Electrical Code
- NFPA - National Fire Protection Association
- UL - Underwriters Laboratory
- CSA - Canadian Standards Association

QUALIFICATIONS

QUALIFIED INSTALLER OR SERVICE AGENCY

Installation and service of this water heater requires ability equivalent to that of a Qualified Agency (as defined by ANSI below) in the field involved. Installation skills such as plumbing, air supply, venting, gas supply and electrical supply are required in addition to electrical testing skills when performing service.

ANSI Z223.1 2006 Sec. 3.3.83: "Qualified Agency" - "Any individual, firm, corporation or company that either in person or through a representative is engaged in and is responsible for (a) the installation, testing or replacement of gas piping or (b) the connection, installation, testing, repair or servicing of appliances and equipment; that is experienced in such work; that is familiar with all precautions required; and that has complied with all the requirements of the authority having jurisdiction."

If you are not qualified (as defined by ANSI above) and licensed or certified as required by the authority having jurisdiction to perform a given task do not attempt to perform any of the procedures described in this manual. If you do not understand the instructions given in this manual do not attempt to perform any procedures outlined in this manual.

ICOMM™ & BACNET COMPATIBLE

This water heater is compatible with the iCOMM™ remote monitoring system. The iCOMM™ system hardware and monitoring service is purchased separately. It allows users to monitor critical operational, diagnostic and energy usage data from a secure web site.

The iCOMM™ system can automatically notify selected personnel via email and/or cellular phone text messages if operational problems or user defined Alert Conditions occur.

iCOMM™ system hardware is compatible with BACnet compliant supervisory controls and building management systems. For more information call 888 928-3702.

PREPARING FOR THE INSTALLATION

1. Read the entire manual before attempting to install or operate the water heater. Pay close attention to the General Safety Information on page 4 and 5. If you don't follow the safety rules, the water heater may not operate safely. It could cause property damage, injury and/or death.

   This manual contains instructions for the installation, operation, and maintenance of the water heater. It also contains warnings throughout the manual that you must read and be aware of. All warnings and all instructions are essential to the proper operation of the water heater and your safety.

   Detailed installation diagrams are also found in this manual. These diagrams will serve to provide the installer with a reference. It is essential that all venting, water piping, gas piping and wiring be installed as shown.

   Particular attention should be given to the installation of thermometers at the locations indicated in the piping diagrams as these are necessary for checking the operation of the water heater.

   The principal components of the water heater are identified in Features And Components on page 7 in this manual. Use this reference to locate and identify various components on the water heater.

   See Installation Checklist on page 58. By using this checklist the user may be able to make minor operational adjustments and avoid unnecessary service calls. However, service and diagnostic procedures should only be performed by a Qualified Service Agency.

   NOTE: Costs to correct installation errors are not covered under the limited warranty.

2. Be sure to turn off power when working on or near the electrical system of the water heater. Never touch electrical components with wet hands or when standing in water.

3. The installation must conform to all instructions contained in this manual and the local code authority having jurisdiction. These shall be carefully followed in all cases. Authorities having jurisdiction should be consulted before installation begins if there are any questions regarding compliance with local, state or national codes.

   In the absence of local codes, the installation must comply with the current editions of the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and the National Electrical Code, NFPA 70 or CAN/CSA-B149.1, the Natural Gas and Propane Installation Code and CSA C22.1, the Canadian Electrical Code. All documents are available from the Canadian Standards Association, 8501 East Pleasant Valley Road, Cleveland, OH 44131. NFPA documents are also available from the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269.

4. If after reading this manual you have any questions or do not understand any portion of the instructions, call the toll free number on the back cover of this manual for technical assistance. In order to expedite your request, please have the full Model, Serial and Series number of the water heater you are working with available for the technician. This information is located on the water heater's rating label.

5. Carefully plan the placement of the water heater. Examine the location to ensure that it complies with the requirements in Locating The Water Heater on page 12 and the Rough In Dimensions on page 11.

6. For installation in California this water heater must be braced or anchored to avoid falling or moving during an earthquake. See instructions for correct installation procedures. Instructions may be obtained from California Office of the State Architect, 1102 Q Street, Suite 5100, Sacramento, CA 95811.

7. Massachusetts Code requires this water heater to be installed in accordance with Massachusetts 248-CMR 2.00: State Plumbing Code and 248-CMR 5. See Commonwealth of Massachusetts on page 21.

FEATURES AND COMPONENTS

BASIC OPERATION

The water heaters covered in this manual have a helical coil shaped heat exchanger that is submerged in the storage tank. The water heater's Main Burner is a radial design burner, it is mounted on the top and fires downward through the heat exchanger. This is a forced draft burner; hot burning gases are forced through the heat exchanger under pressure and exit through the exhaust/vent connection located at the bottom of the water heater. See Figure 1 and Figure 2.

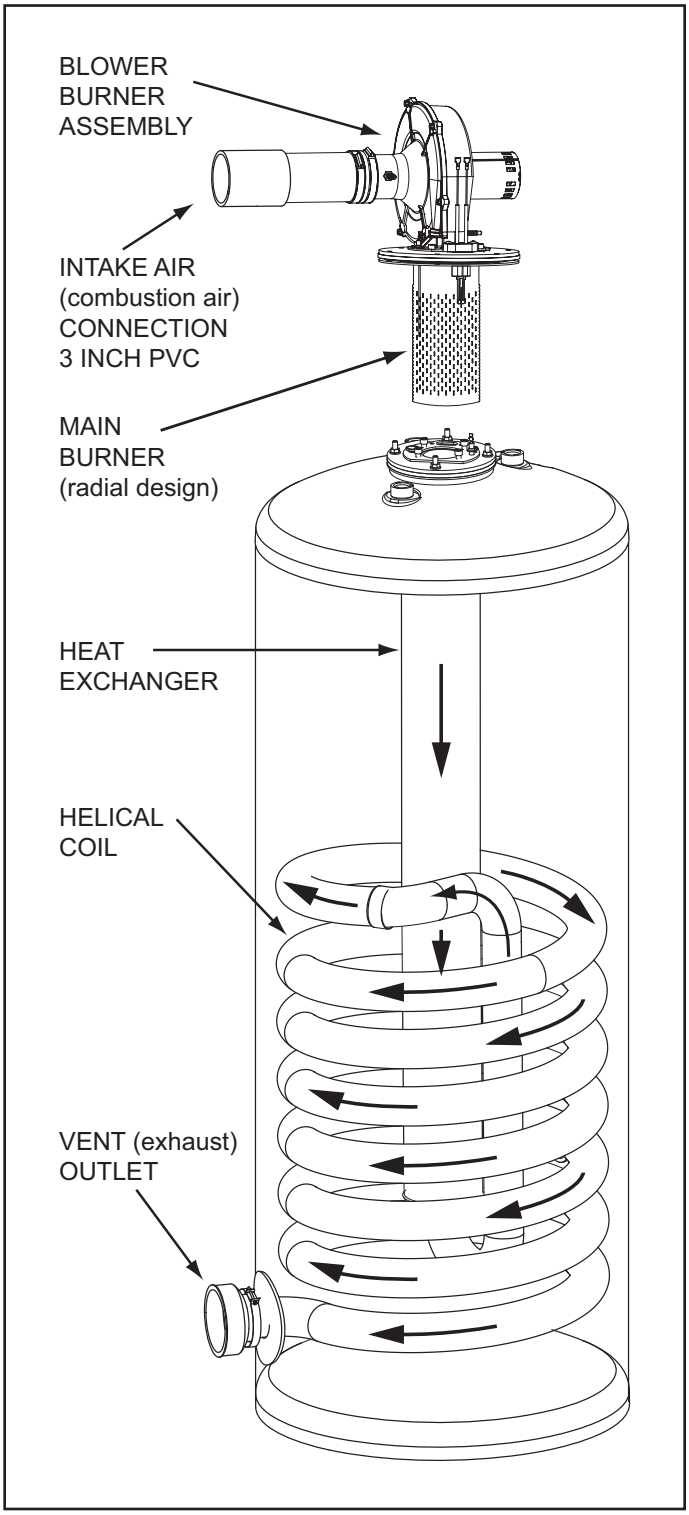


Figure 1

BLOWER/BURNER ASSEMBLY DETAIL

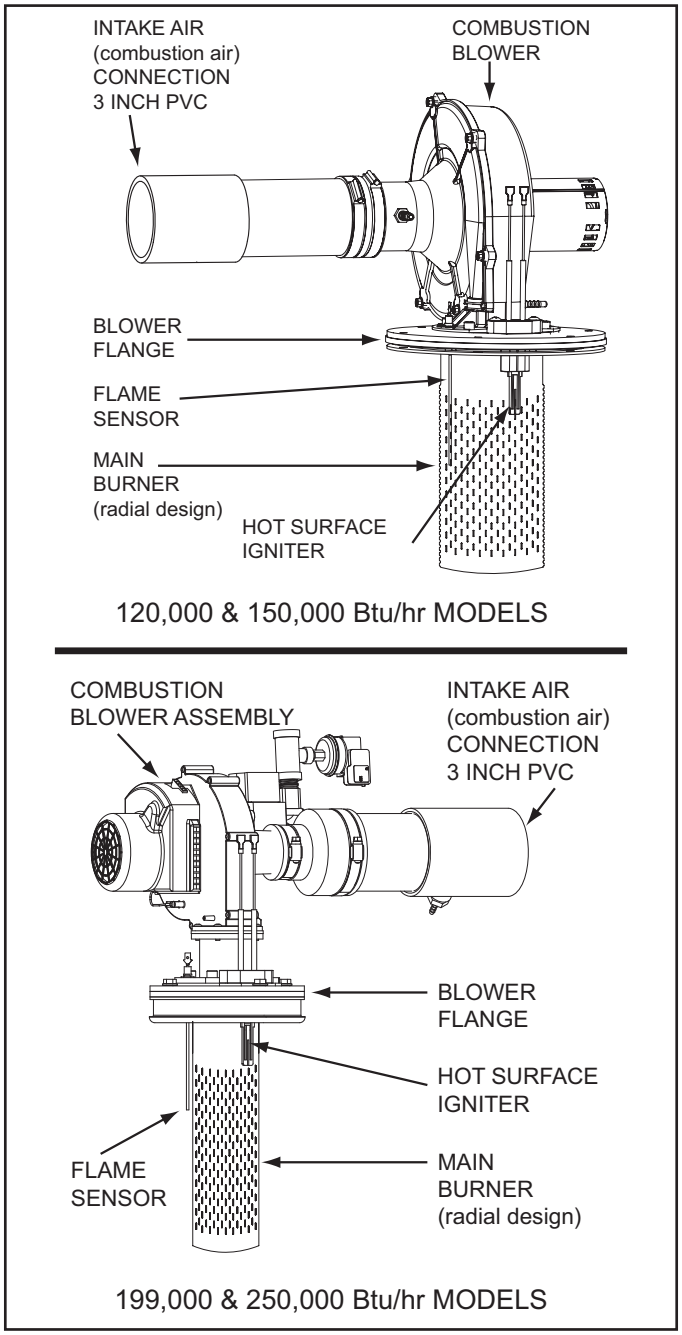


Figure 2

Hot Surface Igniter

The control system energizes the Hot Surface Igniter with 120 VAC during the igniter warm up period. When the igniter is energized it produces sufficient heat, >1800°F (>982°C), to ignite the Main Burner.

NOTE: Care must be taken when handling the igniter to prevent breakage.

Flame Sensor

The control system also monitors the flame sensor to confirm a flame is present at the Main Burner. If a flame is not verified during the ignition trial period (3-5 seconds) the control system will immediately de-energize the 24 Volt Gas Valve. See the Sequence of Operation Flowchart on page 59.

TOP VIEWS

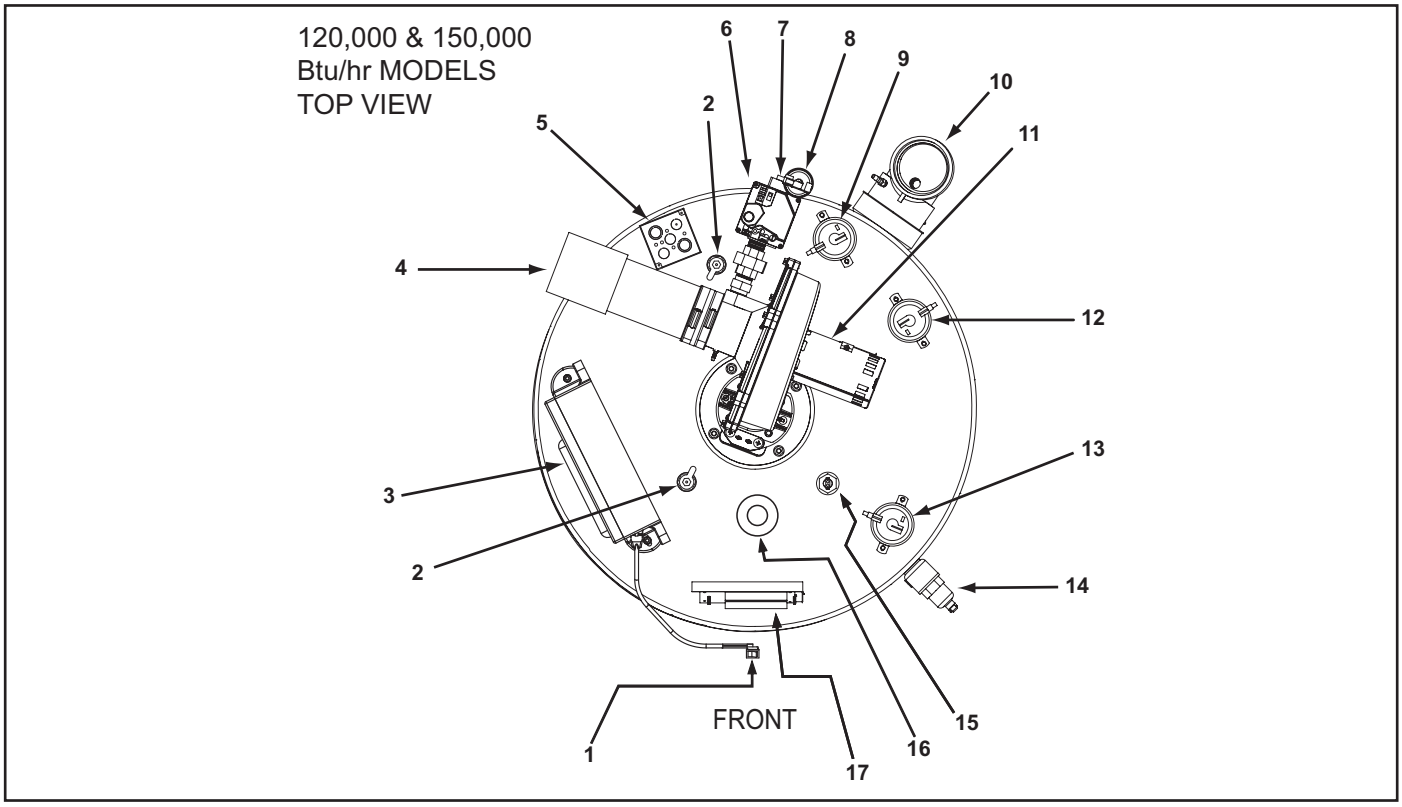


Figure 3

BTH 120 & 150 COMPONENTS

1. Water Heater's 120 VAC on/off switch.
2. Powered anode rods. The water heater's covered in this manual are equipped with powered (non sacrificial) anode rod(s). The BTH 120 has one powered anode, all other models will have two. Protective current is fed by the control system to the titanium electrodes at the end of each anode rod. This current flows through the water to the conductive surfaces inside the storage tank which diminishes the corrosive effect (rusting) of water when it comes in contact with steel.
3. Central Control Board (CCB) enclosure. This enclosure houses the control system's main circuit board. The CCB regulates water temperature and controls all water heater functions, see Control System Operation on page 44.
4. Intake air connection - 3 inch PVC.
5. 120 VAC junction box. Incoming power supply and ground connections are made here. See Power Supply on page 14.
6. Water heater's 24 Volt Gas Valve.
7. Supply gas line connection. See the requirements for the Supply Gas Line on page 14.
8. Low Gas Pressure switch. Normally open contacts that close on a rise in pressure. This switch is used to insure supply gas pressure is above minimum requirements. The control system monitors this switch and will disable heating operation if its contacts are open during a heating cycle. See Table 4 and the Gas Pressure Requirements on page 14.
9. Blocked Intake Air switch. Normally closed contacts that open on fall in pressure. This switch is used to insure intake (combustion) air to the water heater is not restricted. The control system monitors this switch and will disable heating operation if its contacts are open during a heating cycle.
10. Vent connection (exhaust elbow) - 3 inch PVC.
11. Combustion Blower.
12. Blocked Exhaust (vent) switch. Normally closed contacts that open on a rise in pressure. This switch is used to insure the Exhaust (vent) piping connected to the water heater is not restricted. The control system monitors this switch and will disable heating operation if its contacts are open during a heating cycle.
13. Blower Prover switch. Normally open contacts that close on a rise in pressure. This switch is used to insure the Combustion Blower is operating properly. The control system monitors this switch and will disable heating operation if its contacts are closed before the Combustion Blower is energized or open any time during a heating cycle. See Sequence of Operation on page 59.
14. Temperature-Pressure Relief Valve. See Temperature-Pressure Relief Valve on page 16.
15. Upper Temperature Probe, 1 of 2 temperature probes. The water heater's control system monitors this probe to detect water temperature in the upper portion of the storage tank.

    The Upper Temperature Probe also houses the ECO (energy cut out) switch. This is a non adjustable high temperature limit switch. The ECO switch contacts are normally closed and will open on a temperature rise. See High Temperature Limit Control (ECO) on page 43.
16. Water outlet connection 1 1/2" NPT.
17. UIM (user interface module). The UIM includes the display circuit board, the control system's LCD display and operational buttons. Used to adjust various user settings and view operational information. See Control System Operation on page 44.

TOP VIEWS (CONT)

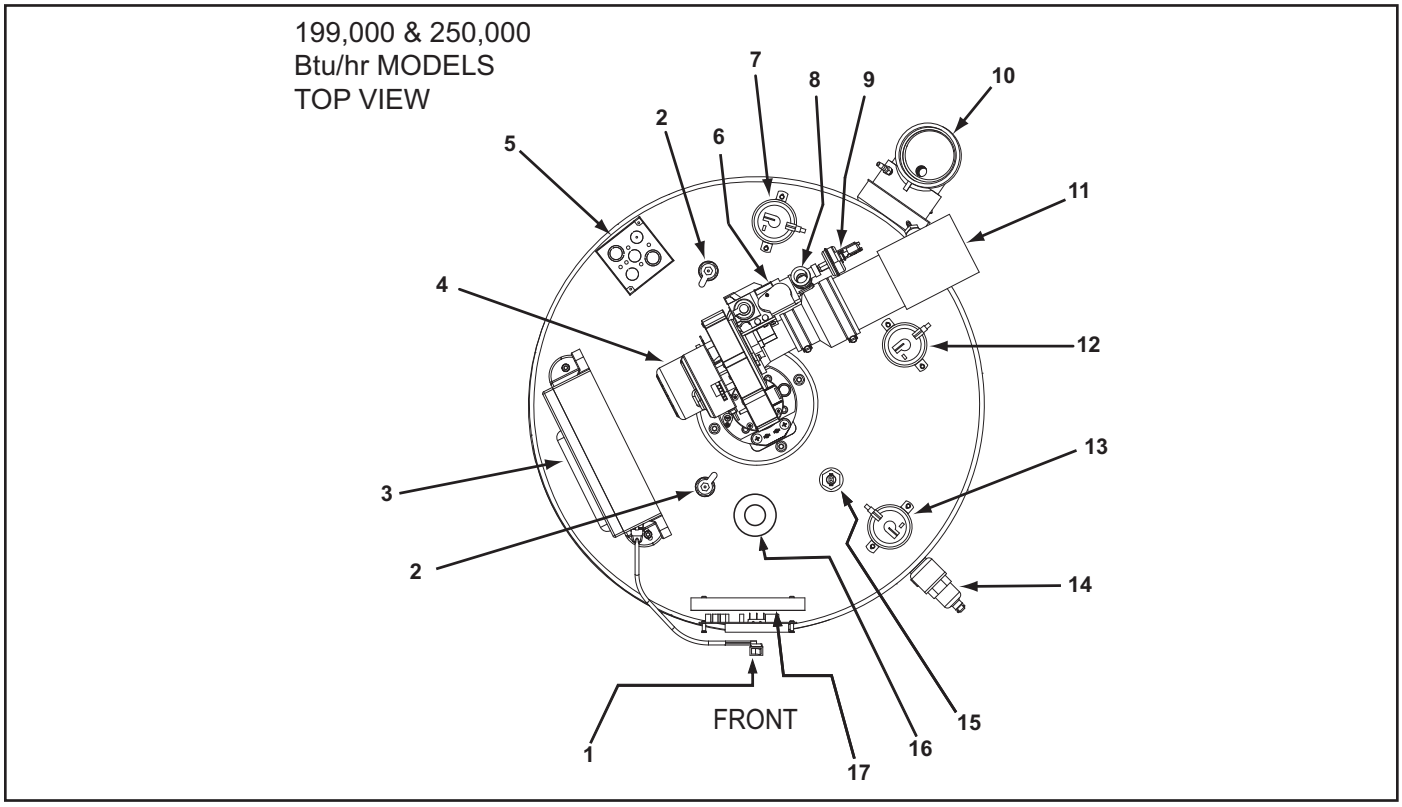


Figure 4

BTH 199 & 250 COMPONENTS

1. Water Heater's 120 VAC on/off switch.
2. Powered anode rods. The water heater's covered in this manual are equipped powered (non sacrificial) anode rods. The BTH 120 has one powered anode, all other models will have two. Protective current is fed by the control system to the titanium electrodes at the end of each anode rod. This current flows through the water to the conductive surfaces inside the storage tank which diminishes the corrosive effect (rusting) of water when it comes in contact with steel.
3. Central Control Board (CCB) enclosure. This enclosure houses the control system's main circuit board. The CCB regulates water temperature and controls all water heater functions, see Control System Operation on page 44.
4. EBM Combustion Blower Assembly includes VFD (variable frequency drive), Gas Valve and Venturi gas feed system.
5. 120 VAC junction box. Incoming power supply and ground connections are made here. See Power Supply on page 14.
6. Water heater's 24 Volt Gas Valve.
7. Blocked Intake Air switch. Normally closed contacts that open on fall in pressure. This switch is used to insure intake (combustion) air to the water heater is not restricted. The control system monitors this switch and will disable heating operation if its contacts are open during a heating cycle.
8. Supply gas line connection. See the requirements for the Supply Gas Line on page 14.
9. Low Gas Pressure switch. Normally open contacts that close on a rise in pressure. This switch is used to insure supply gas pressure is above minimum requirements. The control system monitors this switch and will disable heating operation if its contacts are open during a heating cycle. See Table 4 and the Gas Pressure Requirements on page 14.
10. Vent connection (exhaust elbow) - 3 inch PVC.
11. Intake air connection - 3 inch PVC.
12. Blocked Exhaust (vent) switch. Normally closed contacts that open on a rise in pressure. This switch is used to insure the Exhaust (vent) piping connected to the water heater is not restricted. The control system monitors this switch and will disable heating operation if its contacts are open during a heating cycle.
13. Blower Prover switch. Normally open contacts that close on a rise in pressure. This switch is used to insure the Combustion Blower is operating properly. The control system monitors this switch and will disable heating operation if its contacts are closed before the Combustion Blower is energized or open any time during a heating cycle. See Sequence of Operation on page 58
14. Temperature-Pressure Relief Valve. See Temperature-Pressure Relief Valve on page 16.
15. Upper Temperature Probe, 1 of 2 temperature probes. The water heater's control system monitors this probe to detect water temperature in the upper portion of the storage tank.

    The Upper Temperature Probe also houses the ECO (energy cut out) switch. This is a non adjustable high temperature limit switch. The ECO switch contacts are normally closed and will open on a temperature rise. See High Temperature Limit Control (ECO) on page 43.
16. Water outlet connection 1 1/2" NPT.
17. UIM (user interface module). The UIM includes the display circuit board, the control system's LCD display and operational buttons. Used to adjust various user settings and view operational information. See Control System Operation on page 44.

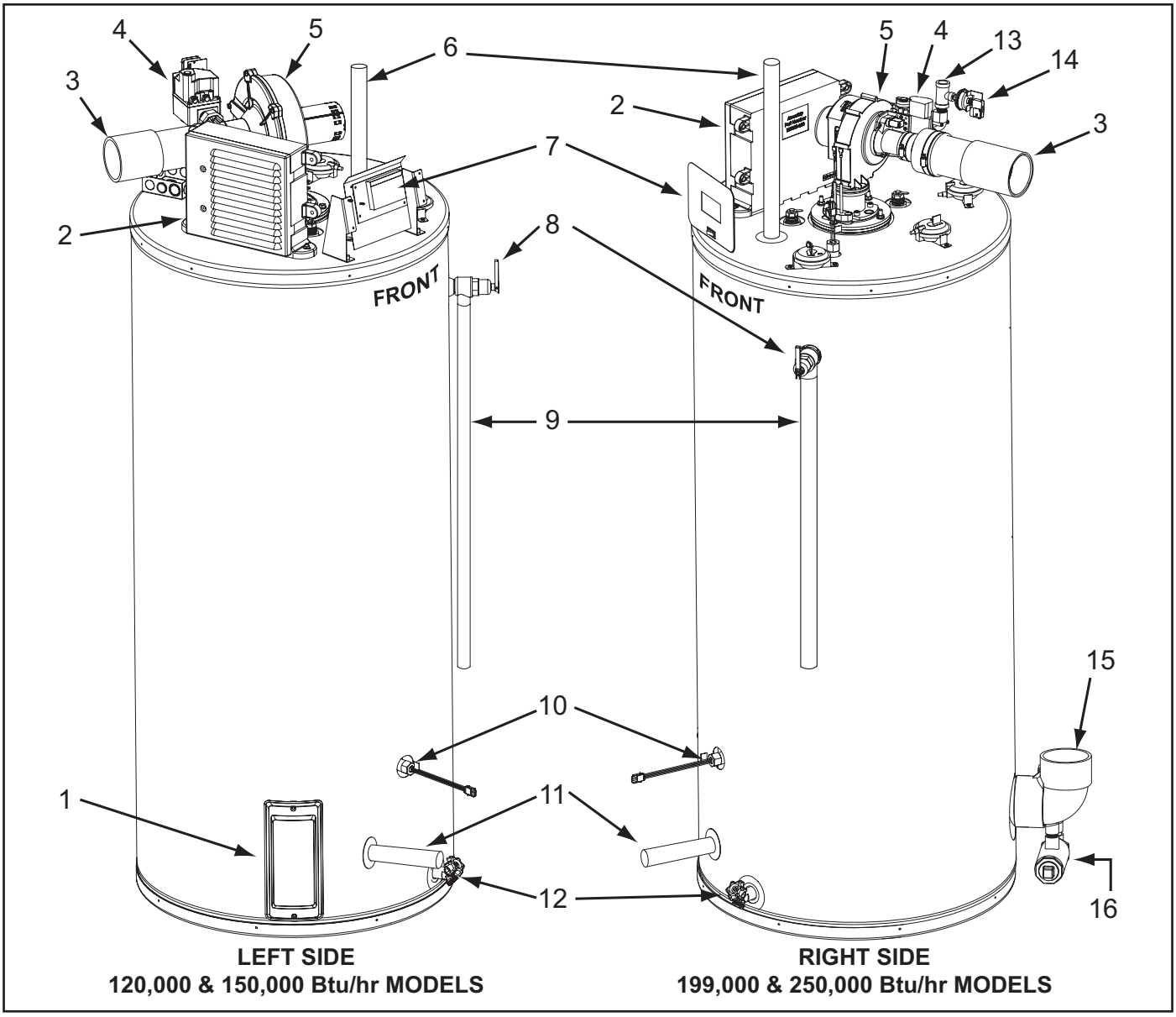


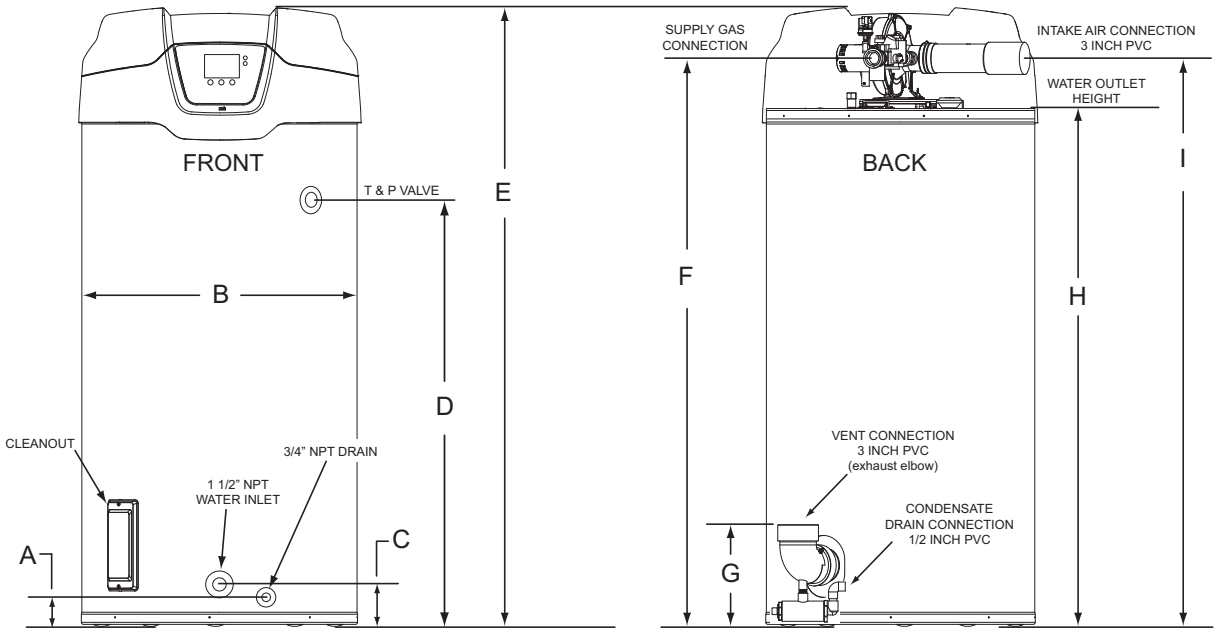
Figure 5

SIDE VIEWS

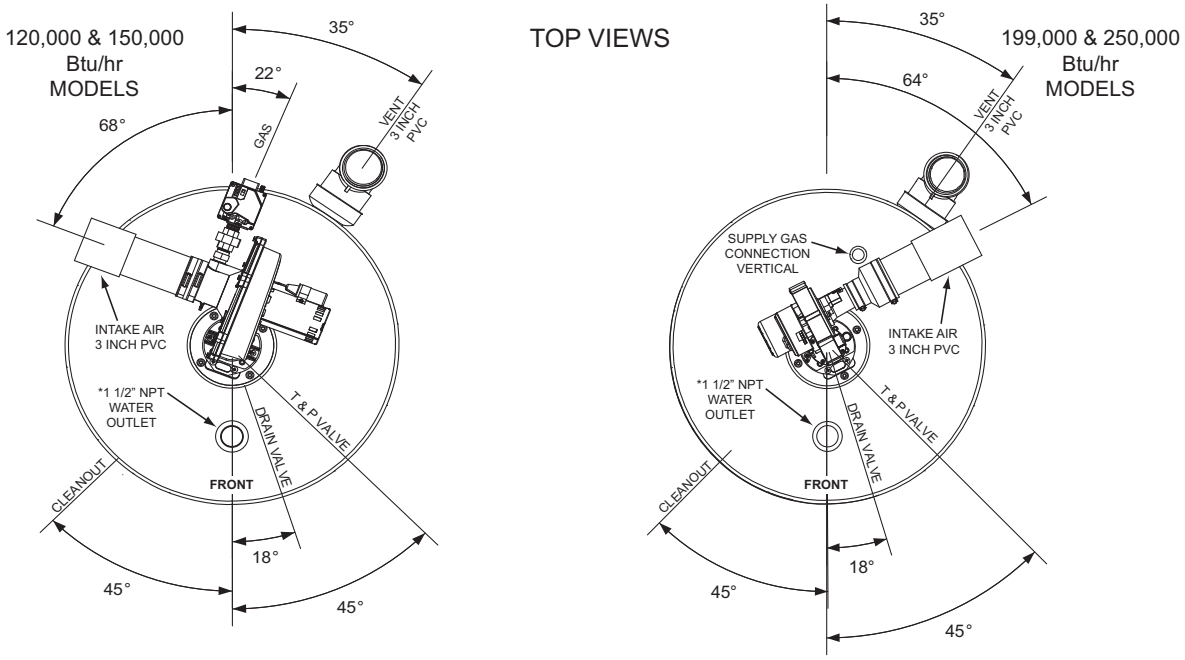
1. Cleanout access panel, covers water heater cleanout opening.
2. CCB enclosure - see beginning on page 8 for description.
3. Intake air connection - 3 inch PVC.
4. Water heater 24 Volt Gas Valve.
5. Combustion Blower.
6. Water outlet pipe - 1 1/2” NPT connection.
7. UIM (user interface module). The UIM includes the display circuit board, the control system’s LCD display and operational buttons. Used to adjust various user settings and view operational information. See Control System Operation on page 44.
8. Temperature-Pressure Relief Valve. See Temperature-Pressure Relief Valve on page 16.
9. Temperature-Pressure Relief Valve discharge pipe - see T&P Valve Discharge Pipe Requirements: on page 16.
10. Lower Temperature Probe, 1 of 2 temperature probes. The water heater’s control system monitors this probe to detect water temperature in the lower portion of the storage tank.
11. Water inlet pipe - 1 1/2” NPT connection.
12. Water heater drain valve.
13. Supply gas line connection. See Supply Gas Line on page 14.
14. Low Gas Pressure switch, see description under beginning on page 8. See Table 4 and the Gas Pressure Requirements on page 14.
15. Vent connection (exhaust elbow) - 3 inch PVC.
16. Condensate trap with 1/2 inch PVC drain connection. See Figure 9 on page 17 and Condensate Drain Installation on page 38.

INSTALLATION CONSIDERATIONS

ROUGH IN DIMENSIONS



These designs comply with the current edition of the American National Standard for Gas Water Heaters, Volume III, ANSI Z21.10.3 / CSA 4.3 as an automatic circulating tank water heater, and automatic storage water heaters.



* Center line of water outlet on top of the water heaters is approximately 7 inches from the front edge of the water heater.

MODEL	DIMENSIONS									SHIP WEIGHT STD	SHIP WEIGHT ASME
	A	B	C	D	E	F	G	H	I		
	INCHES/CM	INCHES/CM	INCHES/CM	INCHES/CM	INCHES/CM	INCHES/CM	INCHES/CM	INCHES/CM	INCHES/CM	LBS/KG	LBS/KG
BTH 120	3/7.62	27.75/70.5	6.3/16	35/88.9	55.5/141	48/121.9	11/27.9	42/106.7	47.5/120.6	460/208	490/222
BTH 150	3/7.62	27.75/70.5	6.3/16	55.5/141	75.5/191.8	68.5/174	11/27.9	63/160	69/175.3	555/252	595/270
BTH 199	3/7.62	27.75/70.5	6.3/16	55.5/141	75.5/191.8	75.5/191.8	11/27.9	63/160	69/175.3	555/252	595/270
BTH 250	3/7.62	27.75/70.5	6.3/16	55.5/141	75.5/191.8	75.5/191.8	11/27.9	63/160	69/175.3	555/252	595/270

Figure 6

GAS LINE CONNECTION SIZE

TABLE 1

† MODEL	SERIES	NATURAL GAS	PROPANE GAS
BTH 120	100/101	3/4 "NPT	3/4 "NPT
BTH 150	100/101	3/4 "NPT	3/4 "NPT
BTH 199	100/101	3/4 "NPT	3/4 "NPT
BTH 250	100/101	3/4 "NPT	3/4 "NPT

† Depending on the installed equivalent length, and/or the number of appliances connected, the supply gas line size may have to be increased beyond the minimum required sizes - see Gas Line Sizing on page 39.

STORAGE CAPACITIES

TABLE 2

MODEL	U. S. GALLONS	LITERS
BTH 120	60	227
BTH 150	100	379
BTH 199	100	379
BTH 250	100	379

RECOVERY CAPACITIES

TABLE 3

					U. S. GALLONS/HR & LITTERS/HR AT TEMPERATURE RISE INDICATED											
Model	Type of Gas	Input		°F	30°F	40°F	50°F	60°F	70°F	80°F	90°F	100°F	110°F	120°F	130°F	140°F
		Btu/hr	kW	°C	17°C	22°C	28°C	33°C	39°C	44°C	50°C	56°C	61°C	67°C	72°C	78°C
BTH 120	Natural	120,000	35	GPH	461	345	276	230	197	173	154	138	126	115	106	99
	Propane			LPH	1744	1308	1046	872	747	654	581	523	476	436	402	374
BTH 150	Natural	150,000	44	GPH	576	432	345	288	247	216	192	173	157	144	133	123
	Propane			LPH	2179	1635	1308	1090	934	817	726	654	594	545	503	467
BTH 199	Natural	199,900	58	GPH	767	575	460	384	329	288	256	230	209	192	177	164
	Propane			LPH	2904	2178	1743	1452	1245	1089	968	871	792	726	670	622
BTH 250	Natural	250,000	73	GPH	960	720	576	480	411	360	320	288	262	240	221	206
	Propane			LPH	3632	2724	2179	1816	1557	1362	1211	1090	991	908	838	778

Recovery capacities are based on 95% thermal efficiency.

LOCATING THE WATER HEATER

Carefully choose a location for the new water heater. The placement is a very important consideration for the safety of the occupants in the building and for the most economical use of the appliance.

CAUTION

Property Damage Hazard

- All water heaters eventually leak.
- Do not install without adequate drainage.

Whether replacing an existing water heater or installing the water heater in a new location observe the following critical points:

1. The water heater must be located indoors.
2. The water heater must not be located in an area where it will be subject to freezing temperatures.
3. Locate the water heater so it is protected and not subject to physical damage by a moving vehicle.
4. Locate the water heater on a level surface.
5. Locate the water heater near a floor drain. The water heater should be located in an area where leakage of the tank or connections will not result in damage to the area adjacent to the water heater or to lower floors of the structure. When such locations cannot be avoided, it is recommended that a metal drain pan, adequately drained, be installed under the appliance.
6. Locate the water heater close to the point of major hot water usage.
7. Locate the water heater close to a 120 VAC power supply. See Power Supply on page 14 for requirements.
8. Locate the water heater where an adequate supply of fresh air for combustion and ventilation can be obtained. See Air Requirements on page 18.
9. Locate the water heater where the vent and intake air piping, when installed, will remain within the maximum equivalent lengths allowed. See Venting Requirements on page 24.
10. Do not locate the water heater where noise (such as the Combustion Blower) during normal operation will be objectionable in adjacent areas.
11. Do not locate the water heater where the subsequent installation of the vent (exhaust) or intake air terminations would be objectionable due to noise at the termination(s). This includes locations close to or across from windows and doors. See Venting Installation on page 22.

⚠ WARNING

Fire or Explosion Hazard

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- Avoid all ignition sources if you smell gas.
- Do not expose water heater controls to excessive gas pressure.
- Use only the gas shown on the water heater rating label.
- Maintain required clearances to combustibles.
- Keep ignition sources away from faucets after extended periods of non-use.

Read instruction manual before installing, using or servicing water heater.

There is a risk in using fuel burning appliances such as gas water heaters in rooms, garages or other areas where gasoline, other flammable liquids or engine driven equipment or vehicles are stored, operated or repaired. Flammable vapors are heavy and travel along the floor and may be ignited by the water heater's igniter or Main Burner flames causing fire or explosion.

Flammable items, pressurized containers or any other potential fire hazardous articles must never be placed on or adjacent to the water heater.

CLEARANCE TO COMBUSTIBLE MATERIALS

The water heaters covered in this manual are approved for installation on combustible flooring. The clearance to combustible and non combustible construction materials is 0 inches on the back and sides of the water heater. These water heaters are also approved for installation in an alcove.

NOTE: Adequate clearance for servicing should be maintained on all installations. See Service Clearance below.

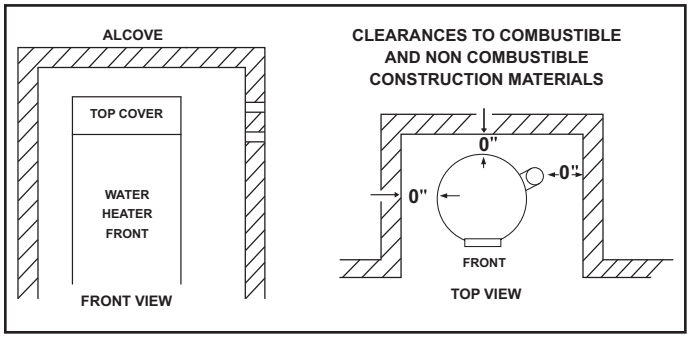


Figure 7

SERVICE CLEARANCE

A service clearance of 24 inches (61 cm) should be maintained from serviceable parts such as the T&P valve, control system components, gas valve, clean out opening, drain valve, the vent connection (exhaust elbow) and the condensate drain. Leave as much room as possible above the water heater and near the exhaust elbow for this reason. See Figure 9 on page 17.

INTAKE AIR AND VENT PIPE CLEARANCES

The minimum clearance from combustible materials for the vent (exhaust) and intake air piping shall be 0 inches. Vent or intake air piping passing through a combustible wall or ceiling must be a continuous run (no joints).

EXTENDED VENT TERMINATIONS

The water heaters covered by this manual can be installed using 3 inch pipe for the intake air and/or vent piping up to a maximum of 50 equivalent feet (15.2 m). The intake air and/or vent piping can be extended up to 120 equivalent feet (36.5 m) by installing 4 inch pipe. See the Venting Requirements on page 24.

The water heater ships from the factory with two (2) 3 inch terminations that are 45° PVC elbows with a debris screen installed. When 4 inch intake air or vent pipe is installed, factory supplied 4 inch terminations must be used.

Contact your local distributor or call the parts department phone number listed on the back cover of this manual to order 4 inch termination(s).

OPTIONAL CONCENTRIC TERMINATIONS

The water heaters covered in this manual can be installed in a Direct Vent configuration using an optional concentric termination. See Concentric Termination Installation on page 30.

HARD WATER

Where hard water conditions exist, water softening or the threshold type of water treatment is recommended. This will protect the dishwashers, coffee urns, water heaters, water piping and other equipment. See Maintenance on page 64 for sediment and lime scale removal procedures.

CIRCULATION PUMPS

A circulating pump is used when a system requires a circulating loop or there is a storage tank used in conjunction with the water heater. See the Water Piping Diagrams beginning on page 71 for installation location of circulating pumps.

See Circulation Pump Wiring Diagrams on page 70 for electrical hookup information. Install in accordance with the current edition of the National Electrical Code, NFPA 70 or the Canadian Electrical Code, CSA C22.1.

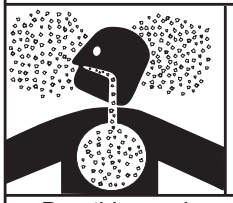
All-bronze circulators are recommended for used with commercial water heaters.

Some circulating pumps are manufactured with sealed bearings and do not require further lubrication. Some circulating pumps must be periodically oiled. Refer to the pump manufacturer's instructions for lubrication requirements.

INSULATION BLANKETS

⚠ WARNING

Breathing Hazard - Carbon Monoxide Gas



- Do not obstruct water heater air intake with insulating blanket.
- Gas and carbon monoxide detectors are available.
- Install water heater in accordance with the instruction manual.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

Insulation blankets are available to the general public for external use on gas water heaters but are not necessary with these products. The purpose of an insulation blanket is to reduce the standby heat loss encountered with storage tank heaters. The water heaters covered by this manual meet or exceed the Energy Policy Act standards with respect to insulation and standby heat loss requirements, making an insulation blanket unnecessary.

Should you choose to apply an insulation blanket to this heater, you should follow these instructions. See the Features and Components section of this manual for identification of components mentioned below. Failure to follow these instructions can restrict the air flow required for proper combustion, potentially resulting in fire, asphyxiation, serious personal injury or death.

- **DO NOT** apply insulation to the top of the water heater, as this will interfere with safe operation of the blower assembly.
- **DO NOT** cover the control system LCD on top of the water heater.
- **DO NOT** cover the Temperature-Pressure Relief Valve.
- **DO NOT** cover the instruction manual. Keep it on the side of the water heater or nearby for future reference.
- **DO** obtain new warning and instruction labels from the manufacturer for placement on the blanket directly over the existing labels.
- **DO** inspect the insulation blanket frequently to make certain it does not sag, thereby obstructing combustion air flow.

INSTALLATION REQUIREMENTS

GAS PRESSURE REQUIREMENTS

TABLE 4

MODEL	*MANIFOLD PRESSURE		†MINIMUM SUPPLY PRESSURE		‡MAXIMUM SUPPLY PRESSURE	
	NATURAL GAS	PROPANE GAS	NATURAL GAS	PROPANE GAS	NATURAL GAS	PROPANE GAS
BTH 120	4” W. C. (1.0 kPa)	10” W. C. (2.49 kPa)	4.9” W. C. (1.22 kPa)	11” W. C. (2.74 kPa)	10.5” W. C. (2.62 kPa)	14” W. C. (3.49 kPa)
BTH 150	4” W. C. (1.0 kPa)	10” W. C. (2.49 kPa)	4.9” W. C. (1.22 kPa)	11” W. C. (2.74 kPa)	10.5” W. C. (2.62 kPa)	14” W. C. (3.49 kPa)
BTH 199	0” W. C. (0 kPa)	0” W. C. (0 kPa)	4.9” W. C. (1.22 kPa)	11” W. C. (2.74 kPa)	10.5” W. C. (2.62 kPa)	14” W. C. (3.49 kPa)
BTH 250	0” W. C. (0 kPa)	0” W. C. (0 kPa)	4.9” W. C. (1.22 kPa)	11” W. C. (2.74 kPa)	10.5” W. C. (2.62 kPa)	14” W. C. (3.49 kPa)

* Manifold gas pressure; reading can only be taken while gas is flowing. Reading taken should be ± 0.3” W. C. of the listed value. 120,000 and 150,000 Btu/hr models are certified for use without modification for altitudes up to 7,700 feet (2,347 m). 199,000 and 250,000 Btu/hr models are certified for use without modification for altitudes up to 10,100 feet (3,078 m). See High Altitude Installations on page 55 for higher elevations.

† Minimum supply gas pressure; readings are taken while gas is not flowing (static pressure) AND while gas is flowing (dynamic pressure). Supply pressure must never fall below the minimum values. Supply gas pressures should be measured with all gas fired appliances connected to a common main firing at full capacity. If supply pressure drops more than 1.5” W. C. as gas begins to flow the supply gas system (gas line/regulator) may be restricted or undersized. See Table 5 and the Supply Gas Regulator requirements below. See Supply Gas Line Installation on page 39 and Supply Gas Regulator on page 14 for sizing and installation instructions also.

‡ Maximum supply gas pressure; reading are taken while gas is not flowing (static pressure) AND while gas is flowing (dynamic pressure). Supply pressure must never exceed this maximum value.

SUPPLY GAS LINE

The high efficiency water heaters covered in this manual require an adequate volume of fuel gas for proper operation. A lack of fuel gas volume can lead to ignition failure, rough starting and rough operation. Increasing the supply gas pressure DOES NOT necessarily increase the volume of gas supplied to the water heater and must remain below the maximum supply gas pressures shown in Table 4.

The minimum supply gas line sizes shown in Table 5 must be observed on all installations to help insure an adequate volume of fuel gas is provided. DO NOT use flexible gas piping.

Supply gas lines serving more than one appliance may require larger sizes than what is shown in Table 5. See Gas Line Sizing on page 39.

MINIMUM SUPPLY GAS LINE SIZE

TABLE 5

† MODEL	NATURAL GAS	PROPANE GAS
BTH 120	3/4” NPT	3/4” NPT
BTH 150	3/4” NPT	3/4” NPT
BTH 199	3/4” NPT	3/4” NPT
BTH 250	3/4” NPT	3/4” NPT

† Depending on the installed equivalent length, and/or the number of appliances connected, the supply gas line size may have to be increased beyond the minimum required sizes shown in this table - see Gas Line Sizing on page 39.

SUPPLY GAS REGULATOR

The maximum allowable gas supply pressure for this waterheater is 10.5 inches W.C. (2.62 kPa) for natural gas and 14.0 inches W.C. (3.49 kPa) for propane. Install a positive lock-up gas pressure regulator in the gas supply line if inlet gas pressure can exceed these pressures at any time.

If a positive lock-up regulator is required follow these instructions:

1. Positive lock-up gas pressure regulators must be rated at or above the input Btu/hr rating of the water heater they supply.
2. Positive lock-up gas pressure regulator(s) should be installed no closer than 3 feet (1 meter) and no farther than 8 feet (2.4 meters) from the water heater’s inlet gas connection.
3. After installing the positive lock-up gas pressure regulator(s) an initial nominal supply pressure setting of 7.0” W.C. while the water heater is operating is recommended and will generally provide good water heater operation. Some addition adjustment maybe required later to maintain a steady gas supply pressure.
4. When installing multiple water heaters in the same gas supply system it is recommended that individual positive lock-up gas pressure regulators be installed at each unit.

POWER SUPPLY

The water heaters covered in this manual require a 120 VAC, 1Ø (single phase), 60Hz, 15 amp power supply and must also be electrically grounded in accordance with local codes or, in the absence of local codes, with the National Electrical Code, ANSI/NFPA 70 or the Canadian Electrical Code, CSA C22.1.

POWER FLUCTUATIONS AND ELECTRICAL NOISE

The water heater’s control system requires a source of stable clean electricity for proper operation. Connecting the water heater to a branch circuit that is subject to fluctuations in voltage level or electrical line noise such as EMI (electro magnetic interference) or RFI (radio frequency interference) may cause erratic control system operation and malfunction.

A high quality power supply filter/suppressor such as the Kleen Line model SELF/T-10 Series SC-L or equivalent must be installed if the above conditions exist. Call the technical support phone number listed on the back cover of this manual for more information.

NOTE: Malfunctions caused by the power supply and the costs to install power supply filters are not covered under the limited warranty.

DEDICATED POWER WIRING AND BREAKERS

Dedicated power supply wires, ground wiring and dedicated circuit breakers often prevent electrical line noise and should be considered when installing the water heater.

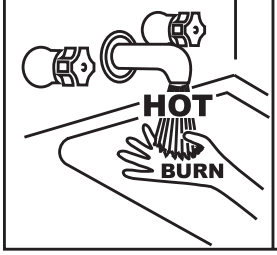
POLARITY SENSITIVE

The control system on the water heaters covered in this manual is polarity sensitive; electronic flame sensing requires correct polarity. The control system is programmed to monitor the incoming power supply. If the Hot and Neutral wires in the 120 VAC power supply are reversed, the control system will declare a Fault condition and lock out, heating operation will be disabled until the power supply is correctly wired. The control system will display the “AC Reversed” Fault message on the LCD.

See Electrical Wiring on page 41 for installation instructions.

MIXING VALVES

⚠ DANGER



Water temperature over 125°F (52°C) can cause severe burns instantly resulting in severe injury or death.

Children, the elderly and the physically or mentally disabled are at highest risk for scald injury.

Feel water before bathing or showering.

Temperature limiting devices such as mixing valves must be installed when required by codes and to ensure safe temperatures at fixtures.

Water heated to a temperature which will satisfy clothes washing, dish washing, and other sanitizing needs can scald and cause permanent injury upon contact. Short repeated heating cycles caused by small hot water uses can cause temperatures at the point of use to exceed the water heater's temperature setting by up to 20°F (11°C).

Some people are more likely to be permanently injured by hot water than others. These include the elderly, children, the infirm and the physically/mentally disabled. Table 6 shows the approximate time-to-burn relationship for normal adult skin. If anyone using hot water provided by the water heater being installed fits into one of these groups or if there is a local code or state law requiring a certain water temperature at the point of use, then special precautions must be taken.

In addition to using the lowest possible temperature setting that satisfies the demand of the application a Mixing Valve should be installed at the water heater (see Figure 8) or at the hot water taps to further reduce system water temperature.

Mixing valves are available at plumbing supply stores. Consult a Qualified Installer or Service Agency. Follow mixing valve manufacturer's instructions for installation of the valves.

TABLE 6

Water Temperature	Time to Produce 2nd & 3rd Degree Burns on Adult Skin
180°F (82°C)	Nearly instantaneous
170°F (77°C)	Nearly instantaneous
160°F (71°C)	About 1/2 second
150°F (66°C)	About 1-1/2 seconds
140°F (60°C)	Less than 5 seconds
130°F (54°C)	About 30 seconds
120°F (49°C)	More than 5 minutes

DISHWASHING MACHINES

All dishwashing machines meeting the National Sanitation Foundation requirements are designed to operate with water flow pressures between 15 and 25 pounds per square inch (103 kPa and 173 kPa). Flow pressures above 25 pounds per square inch (173 kPa), or below 15 pounds per square inch (103 kPa), will result in improperly sanitized dishes. Where pressures are high, a water pressure reducing or flow regulating control valve should be used in the 180°F (82°C) line to the dishwashing machine and should be adjusted to deliver water pressure between these limits.

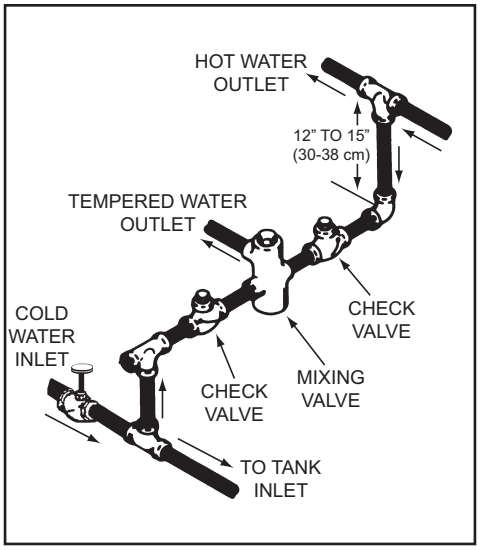


Figure 8

The National Sanitation Foundation also recommends circulation of 180°F (82°C) water. Where this is done, the circulation should be very gentle so that it does not cause any unnecessary turbulence inside the water heater. The circulation should be just enough to provide 180°F (82°C) water at the point of take-off to the dishwashing machine.

Adjust flow by throttling a full port ball valve installed in the circulating line on the outlet side of the pump. Never throttle flow on the suction side of a pump. See the Water Piping Diagrams beginning on page 71.

NOTE: To comply with NSF Standard 5 installation requirements the bottom of the water heater must be sealed to the floor with a silicone based sealant or elevated 6 inches above the floor.

CLOSED WATER SYSTEMS

Water supply systems may, because of code requirements or such conditions as high line pressure, among others, have installed devices such as pressure reducing valves, check valves, and back flow preventers. Devices such as these cause the water system to be a closed system.

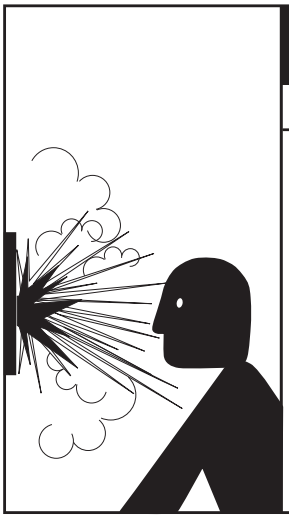
THERMAL EXPANSION

As water is heated, it expands (thermal expansion). In a closed system the volume of water will grow when it is heated. As the volume of water grows there will be a corresponding increase in water pressure due to thermal expansion. Thermal expansion can cause premature tank failure (leakage). This type of failure is not covered under the limited warranty. Thermal expansion can also cause intermittent Temperature-Pressure Relief Valve operation: water discharged from the valve due to excessive pressure build up. This condition is not covered under the limited warranty. The Temperature-Pressure Relief Valve is not intended for the constant relief of thermal expansion.

A properly sized thermal expansion tank must be installed on all closed systems to control the harmful effects of thermal expansion. Contact a local plumbing service agency to have a thermal expansion tank installed.

See Water Line Connections on page 42 and the Water Piping Diagrams beginning on page 71.

TEMPERATURE-PRESSURE RELIEF VALVE



⚠ WARNING

Explosion Hazard

- Temperature-Pressure Relief Valve must comply with ANSI Z21.22-CSA 4.4 and ASME code.
- Properly sized temperature-pressure relief valve must be installed in opening provided.
- Can result in overheating and excessive tank pressure.
- Can cause serious injury or death.

This water heater is provided with a properly rated/sized and certified combination Temperature-Pressure Relief Valve (T&P valve) by the manufacturer. The valve is certified by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment of materials as meeting the requirements for Relief Valves for Hot Water Supply Systems, ANSI Z21.22 • CSA 4.4, and the code requirements of ASME.

If replaced, the new T&P valve must meet the requirements of local codes, but not less than a combination Temperature-Pressure Relief Valve rated/sized and certified as indicated in the above paragraph. The new valve must be marked with a maximum set pressure not to exceed the marked hydrostatic working pressure of the water heater (150 psi = 1,035 kPa) and a discharge capacity not less than the water heater Btu/hr or kW input rate as shown on the water heater's model rating label.

NOTE: In addition to the factory installed Temperature-Pressure Relief Valve on the water heater, each remote storage tank that may be installed and piped to a water heating appliance must also have its own properly sized, rated and approved Temperature-Pressure Relief Valve installed. Call the toll free technical support phone number listed on the back cover of this manual for technical assistance in sizing a Temperature-Pressure Relief Valve for remote storage tanks.

For safe operation of the water heater, the Temperature-Pressure Relief Valve must not be removed from its designated opening nor plugged. The Temperature-Pressure Relief Valve must be installed directly into the fitting of the water heater designed for the relief valve. Install discharge piping so that any discharge will exit the pipe within 6 inches (15.2 cm) above an adequate floor drain, or external to the building. In cold climates it is recommended that it be terminated at an adequate drain inside the building. Be certain that no contact is made with any live electrical part. The discharge opening must not be blocked or reduced in size under any circumstances. Excessive length, over 30 feet (9.14 m), or use of more than four elbows can cause restriction and reduce the discharge capacity of the valve.

No valve or other obstruction is to be placed between the Temperature-Pressure Relief Valve and the tank. Do not connect discharge piping directly to the drain unless a 6" (15.2 cm) air gap is provided. To prevent bodily injury, hazard to life, or property damage, the relief valve must be allowed to discharge water in adequate quantities should circumstances demand. If the discharge pipe is not connected to a drain or other suitable means, the water flow may cause property damage.

CAUTION

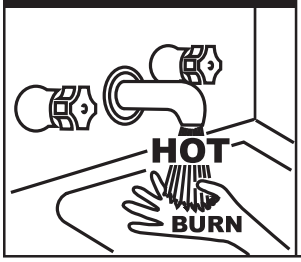
Water Damage Hazard

- Temperature-Pressure Relief Valve discharge pipe must terminate at adequate drain.

T&P Valve Discharge Pipe Requirements:

- Shall not be smaller in size than the outlet pipe size of the valve, or have any reducing couplings or other restrictions.
- Shall not be plugged or blocked.
- Shall not be exposed to freezing temperatures.
- Shall be of material listed for hot water distribution.
- Shall be installed so as to allow complete drainage of both the Temperature-Pressure Relief Valve and the discharge pipe.
- Must terminate a maximum of six inches above a floor drain or external to the building. In cold climates, it is recommended that the discharge pipe be terminated at an adequate drain inside the building.
- Shall not have any valve or other obstruction between the relief valve and the drain.

⚠ DANGER



- Burn hazard.
- Hot water discharge.
- Keep clear of Temperature-Pressure Relief Valve discharge outlet.

The Temperature-Pressure Relief Valve must be manually operated at least twice a year. Caution should be taken to ensure that (1) no one is in front of or around the outlet of the Temperature-Pressure Relief Valve discharge line, and (2) the water manually discharged will not cause any bodily injury or property damage because the water may be extremely hot. If after manually operating the valve, it fails to completely reset and continues to release water, immediately close the cold water inlet to the water heater, follow the draining instructions in this manual, and replace the Temperature-Pressure Relief Valve with a properly rated/sized new one.

NOTE: The purpose of a Temperature-Pressure Relief Valve is to prevent excessive temperatures and pressures in the storage tank. The T&P valve is not intended for the constant relief of thermal expansion. A properly sized thermal expansion tank must be installed on all closed systems to control thermal expansion, see Closed Water Systems and Thermal Expansion on page 15.

If you do not understand these instructions or have any questions regarding the Temperature-Pressure Relief Valve call the toll free number listed on the back cover of this manual for technical assistance.

CONDENSATE DRAIN

The water heaters covered in this manual are condensing appliances and require a building drain to be located in close proximity to allow the condensate to drain safely.

Condensate drains from the water heater at the exhaust elbow located at the bottom. The field installed condensate drain line must not be elevated above the condensate drain connection on the condensate trap, see Figure 9. If the condensate does not drain properly it will build up in the exhaust (vent) elbow. This will restrict the flow of flue gases and cause the Blocked Exhaust pressure switch to open its contacts. The control system monitors all pressure switches, if the Blocked Exhaust Switch contacts are open the control system will lock out and disable heating operation. The “Blocked Exhaust” Fault message will be displayed on the control system’s LCD, see Fault and Alert Conditions beginning on page 61.

NOTE: If the “Blocked Exhaust “ Fault message is ever displayed on the control system LCD, check the condensate drain first and ensure it is not blocked.

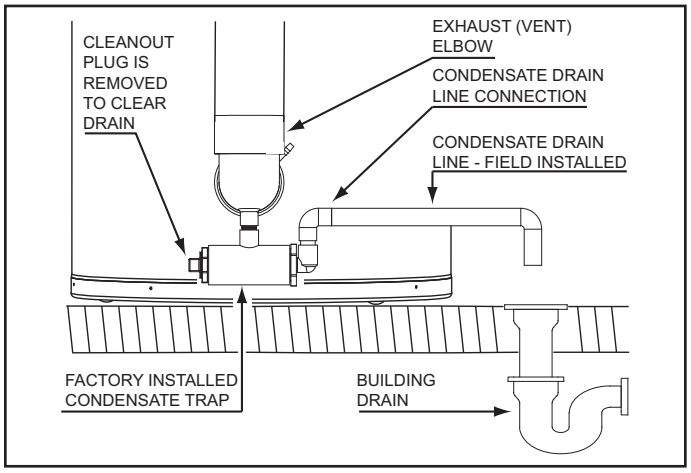

CLEANOUT PLUG IS REMOVED TO CLEAR DRAIN
EXHAUST (VENT) ELBOW
CONDENSATE DRAIN LINE CONNECTION
CONDENSATE DRAIN LINE - FIELD INSTALLED
FACTORY INSTALLED CONDENSATE TRAP
BUILDING DRAIN

Figure 9

CONDENSATE DRAIN WATER TRAP

⚠WARNING

Breathing Hazard - Carbon Monoxide Gas

- Ensure a functioning water trap is installed in the condensate drain.
- Gas and carbon monoxide detectors are available.
- Install water heater in accordance with the instruction manual.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

DO NOT remove the factory installed condensate trap for any reason, see Figure 9. The water heater’s vent pipe is under a slight positive pressure. The water trap prevents flue gases from escaping into the installed space. See Condensate Drain Installation on page 38.

CONDENSATE PH LEVEL

The condensate drains from the water heater’s covered in this manual have PH levels between 4.3 and 5.0. Install a commercially available neutralizing kit if required by local codes.

NOTE: Lower PH levels are acidic. Do not connect a metal drain line, such as copper, to the water heater for this reason. See Condensate Drain Installation on page 38.

COMBUSTIBLE MATERIAL STORAGE

⚠WARNING

Fire or Explosion Hazard

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- Avoid all ignition sources if you smell gas.
- Do not expose water heater controls to excessive gas pressure.
- Use only the gas shown on the water heater rating label.
- Maintain required clearances to combustibles.
- Keep ignition sources away from faucets after extended periods of non-use.

Read instruction manual before installing, using or servicing water heater.

Keep appliance area clear and free of combustible materials, gasoline and other flammable vapors and liquids.

CONTAMINATED AIR

⚠WARNING

Breathing Hazard - Carbon Monoxide Gas

- Install water heater in accordance with the Instruction Manual and NFPA 54 or CAN/CSA-B149.1.
- To avoid injury, combustion and ventilation air must be taken from outdoors.
- Do not place chemical vapor emitting products near water heater.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

Corrosion of the flue ways and vent system may occur if air for combustion contains certain chemical vapors. Such corrosion may result in failure and risk of asphyxiation.

Combustion air that is contaminated can greatly diminish the life span of the water heater and water heater components such as hot surface igniters and burners. Propellants of aerosol sprays, beauty shop supplies, water softener chemicals and chemicals used in dry cleaning processes that are present in the combustion, ventilation or ambient air can cause such damage.

Do not store products of this sort near the water heater. Air which is brought in contact with the water heater should not contain any of these chemicals. If necessary, uncontaminated air should be obtained from remote or outdoor sources. The limited warranty is voided when failure of water heater is due to a corrosive atmosphere. (See limited warranty for complete terms and conditions).

If the water heater will be used in beauty shops, barber shops, cleaning establishments, or self-service laundries with dry cleaning equipment, it is imperative that the water heater(s) be installed in a Direct Vent configuration so that all air for combustion is derived directly from the outdoor atmosphere through a sealed intake air pipe. See Venting Installation on page 22.

AIR REQUIREMENTS

⚠WARNING

Breathing Hazard - Carbon Monoxide Gas

- Install water heater in accordance with the Instruction Manual and NFPA 54 or CAN/CSA-B149.1.
- To avoid injury, combustion and ventilation air must be taken from outdoors.
- Do not place chemical vapor emitting products near water heater.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

For safe operation an adequate supply of fresh uncontaminated air for combustion and ventilation must be provided.

An insufficient supply of air can cause recirculation of combustion products resulting in contamination that may be hazardous to life. Such a condition often will result in a yellow, luminous burner flame, causing sooting of the combustion chamber, burners and flue tubes and creates a risk of asphyxiation.

Do not install the water heater in a confined space unless an adequate supply of air for combustion and ventilation is brought in to that space using the methods described in the Confined Space section that follows.

Never obstruct the flow of ventilation air. If you have any doubts or questions at all, call your gas supplier. Failure to provide the proper amount of combustion air can result in a fire or explosion and cause property damage, serious bodily injury or death.

UNCONFINED SPACE

An Unconfined Space is one whose volume IS NOT LESS THAN 50 cubic feet per 1,000 Btu/hr (4.8 cubic meters per kW) of the total input rating of all appliances installed in the space. Rooms communicating directly with the space, in which the appliances are installed, through openings not furnished with doors, are considered a part of the unconfined space.

Makeup air requirements for the operation of exhaust fans, kitchen ventilation systems, clothes dryers and fireplaces shall also be considered in determining the adequacy of a space to provide combustion, ventilation and dilution air.

UNUSUALLY TIGHT CONSTRUCTION

In unconfined spaces in buildings, infiltration may be adequate to provide air for combustion, ventilation and dilution of flue gases. However, in buildings of unusually tight construction (for example, weather stripping, heavily insulated, caulked, vapor barrier, etc.) additional air must be provided using the methods described in the Confined Space section that follows.

CONFINED SPACE

A Confined Space is one whose volume IS LESS THAN 50 cubic feet per 1,000 Btu/hr (4.8 cm per kW) of the total input rating of all appliances installed in the space.

Openings must be installed to provide fresh air for combustion, ventilation and dilution in confined spaces. The required size for the openings is dependent on the method used to provide fresh air to the confined space AND the total Btu/hr input rating of all appliances installed in the space.

DIRECT VENT APPLIANCES

Appliances installed in a Direct Vent configuration that derive all air for combustion from the outdoor atmosphere through sealed intake air piping are not factored in the total appliance input Btu/hr calculations used to determine the size of openings providing fresh air into confined spaces.

EXHAUST FANS

Where exhaust fans are installed, additional air shall be provided to replace the exhausted air. When an exhaust fan is installed in the same space with a water heater, sufficient openings to provide fresh air must be provided that accommodate the requirements for all appliances in the room and the exhaust fan. Undersized openings will cause air to be drawn into the room through the water heater's vent system causing poor combustion. Sooting, serious damage to the water heater and the risk of fire or explosion may result. It can also create a risk of asphyxiation.

LOUVERS AND GRILLES

The free areas of the fresh air openings in the instructions that follow do not take in to account the presence of louvers, grilles or screens in the openings.

The required size of openings for combustion, ventilation and dilution air shall be based on the "net free area" of each opening. Where the free area through a design of louver or grille or screen is known, it shall be used in calculating the size of opening required to provide the free area specified. Where the louver and grille design and free area are not known, it shall be assumed that wood louvers will have 25% free area and metal louvers and grilles will have 75% free area. Non motorized louvers and grilles shall be fixed in the open position.

FRESH AIR OPENINGS FOR CONFINED SPACES

The following instructions shall be used to calculate the size, number and placement of openings providing fresh air for combustion, ventilation and dilution in confined spaces. The illustrations shown in this section of the manual are a reference for the openings that provide fresh air into confined spaces only. **DO NOT** refer to these illustrations for the purpose of vent installation. See Venting Installation on page 22 for complete venting installation instructions.

OUTDOOR AIR THROUGH TWO OPENINGS

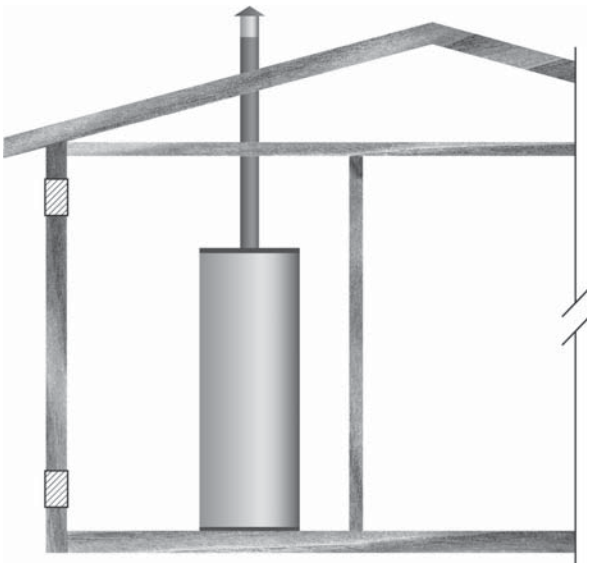


Figure 10

The confined space shall be provided with two permanent openings, one commencing within 12 inches (300 mm) of the top and one commencing within 12 inches (300 mm) of the bottom of the enclosure. The openings shall communicate directly with the outdoors. See Figure 10.

Each opening shall have a minimum free area of 1 square inch per 4,000 Btu/hr (550 mm2 per kW) of the aggregate input rating of all appliances installed in the enclosure. Each opening shall not be less than 100 square inches (645 cm2).

OUTDOOR AIR THROUGH ONE OPENING

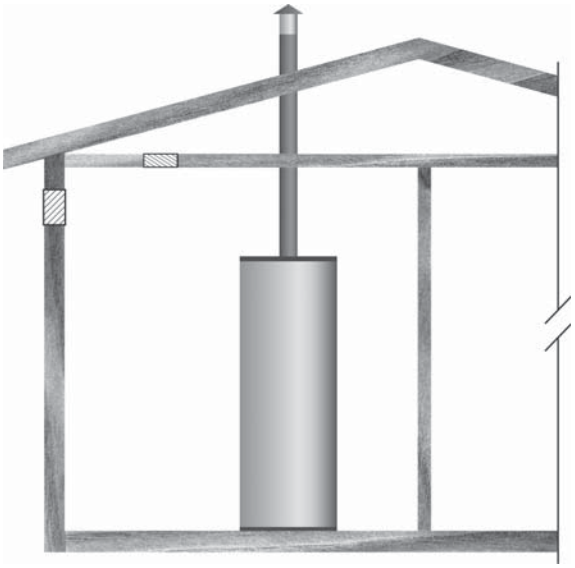


Figure 11

Alternatively a single permanent opening, commencing within 12 inches (300 mm) of the top of the enclosure, shall be provided. See Figure 11. The water heater shall have clearances of at least 1 inch (25 mm) from the sides and back and 6 inches (l50 mm) from the front of the appliance. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that freely communicate with the outdoors and shall have a minimum free area of the following:

1. 1 square inch per 3000 Btu/hr (700 mm2 per kW) of the total input rating of all appliances located in the enclosure, and
2. Not less than the sum of the areas of all vent connectors in the space.

OUTDOOR AIR THROUGH TWO HORIZONTAL DUCTS

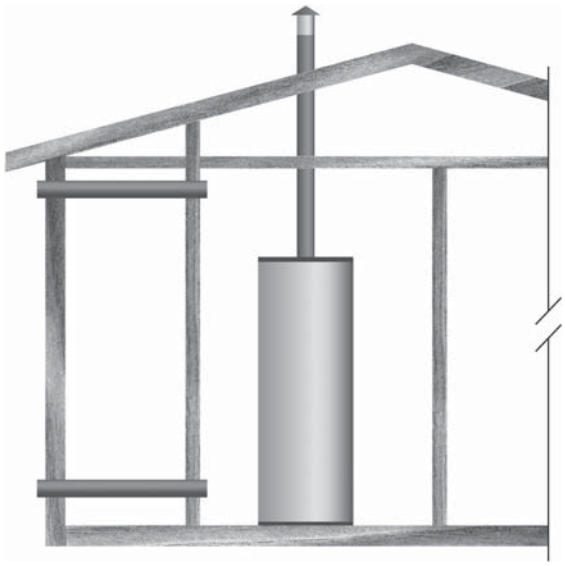


Figure 12

The confined space shall be provided with two permanent horizontal ducts, one commencing within 12 inches (300 mm) of the top and one commencing within 12 inches (300 mm) of the bottom of the enclosure. The horizontal ducts shall communicate directly with the outdoors. See Figure 12.

Each duct opening shall have a minimum free area of 1 square inch per 2,000 Btu/hr (1100 mm2 per kW) of the aggregate input rating of all appliances installed in the enclosure.

When ducts are used, they shall be of the same cross sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be not less than 3 inches.

OUTDOOR AIR THROUGH TWO VERTICAL DUCTS

The illustrations shown in this section of the manual are a reference for the openings that provide fresh air into confined spaces only.

DO NOT refer to these illustrations for the purpose of vent installation. See Venting Installation on page 22 for complete venting installation instructions.

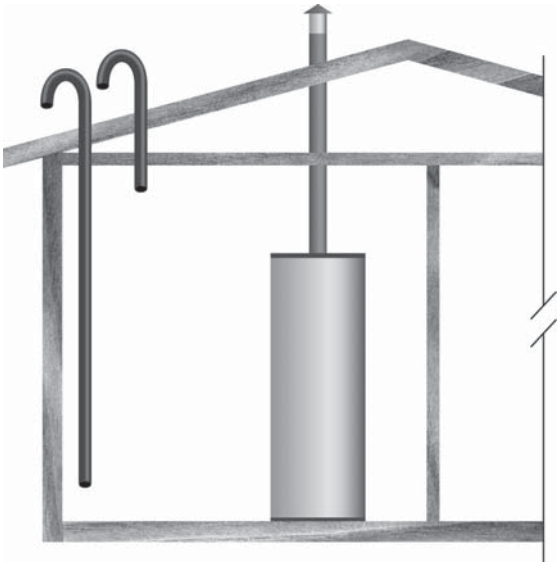


Figure 13

The confined space shall be provided with two permanent vertical ducts, one commencing within 12 inches (300 mm) of the top and one commencing within 12 inches (300 mm) of the bottom of the enclosure. The vertical ducts shall communicate directly with the outdoors. See Figure 13.

Each duct opening shall have a minimum free area of 1 square inch per 4,000 Btu/hr (550 mm2 per kW) of the aggregate input rating of all appliances installed in the enclosure.

When ducts are used, they shall be of the same cross sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be not less than 3 inches.

AIR FROM OTHER INDOOR SPACES

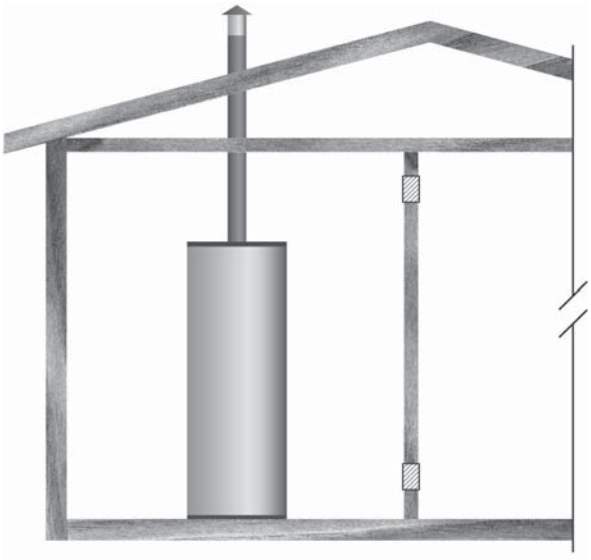


Figure 14

The confined space shall be provided with two permanent openings, one commencing within 12 inches (300 mm) of the top and one commencing within 12 inches (300 mm) of the bottom of the enclosure. See Figure 14.

Each opening shall communicate directly with an additional room(s) of sufficient volume so that the combined volume of all spaces meets the criteria for an Unconfined Space.

Each opening shall have a minimum free area of 1 square inch per 1,000 Btu/hr (1100 mm2 per kW) of the aggregate input rating of all appliances installed in the enclosure. Each opening shall not be less than 100 square inches (645 cm2).

INSTALLATION REQUIREMENTS - COMMONWEALTH OF MASSACHUSETTS

COMMONWEALTH OF MASSACHUSETTS

For all side wall terminated, horizontally vented power vent, direct vent, and power direct vent gas fueled water heaters installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where the side wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches, the following requirements shall be satisfied:

INSTALLATION OF CARBON MONOXIDE DETECTORS

At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gasfitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment is to be installed. In addition, the installing plumber or gasfitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building or structure served by the sidewall horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the installation of hard wired carbon monoxide detectors.

In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.

In the event that the requirements of this subdivision can not be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements provided that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.

APPROVED CARBON MONOXIDE DETECTORS

Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 720 and be ANSI/ UL 2034 listed and CSA certified.

SIGNAGE

A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, **"GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS."**

INSPECTION

The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a) 1 through 4.

EXEMPTIONS

The following equipment is exempt from 248 CMR 5.08(2)(a)1 through 4:

1. The equipment listed in Chapter 10 entitled "Equipment Not Required To Be Vented" in the most current edition of NFPA 54 as adopted by the Board; and
2. Product Approved side wall horizontally vented gas fueled equipment installed in a room or structure separate from the dwelling, building, or structure used in whole or in part for residential purposes.

MANUFACTURER REQUIREMENTS - GAS EQUIPMENT VENTING SYSTEM PROVIDED

When the manufacturer of Product Approved side wall horizontally vented gas equipment provides a venting system design or venting system components with the equipment, the instructions provided by the manufacturer for installation of the equipment and the venting system shall include:

1. Detailed instructions for the installation of the venting system design or the venting system components; and
2. A complete parts list for the venting system design or venting system.

MANUFACTURER REQUIREMENTS - GAS EQUIPMENT VENTING SYSTEM NOT PROVIDED

When the manufacturer of a Product Approved side wall horizontally vented gas fueled equipment does not provide the parts for venting the flue gases, but identifies "special venting systems," the following requirements shall be satisfied by the manufacturer:

1. The referenced "special venting system" instructions shall be included with the appliance or equipment installation instructions; and
2. The "special venting systems" shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.

A copy of all installation instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists for venting instructions, and/or all venting design instructions shall remain with the appliance or equipment at the completion of the installation.

VENTING INSTALLATION

⚠WARNING

Breathing Hazard - Carbon Monoxide Gas

- Install vent system in accordance with codes.
- Do not operate water heater if flood damaged.
- Special consideration must be taken with installations above 10,000 feet (3,048 m) refer to high altitude section of this manual.
- Do not operate if soot buildup.
- Do not obstruct water heater air intake with insulating jacket or blanket.
- Do not place chemical vapor emitting products near water heater.
- Gas and carbon monoxide detectors are available.
- Never operate the heater unless it is vented to the outdoors and has adequate air supply to avoid risks of improper operation, fire, explosion or asphyxiation.
- Analyze the entire vent system to make sure that condensate will not become trapped in a section of vent pipe and therefore reduce the open cross sectional area of the vent.

Breathing carbon monoxide can cause brain damage or death. Always read and understand the instruction manual.

Never operate the water heater unless it is vented to the outdoors.

The instructions in this section of the manual must be followed to avoid choked combustion or recirculation of flue gases. Such conditions cause sooting of the combustion chamber, burners and flue tubes and creates a risk of asphyxiation.

GENERAL VENTING INFORMATION

The water heaters covered in this manual are operationally equivalent to Category IV appliances and may be installed in either a Power Vent or Direct Vent configuration.

CATEGORY IV APPLIANCE

Category IV appliances operate with a positive vent (exhaust) static pressure and with vent gas temperatures low enough to produce condensate in the vent piping.

POWER VENT CONFIGURATION

Power Vent configurations derive all combustion air from the room where they are installed and discharge all flue gases to the outdoor atmosphere through a sealed vent (exhaust) pipe. Power vent configurations have one vent pipe connected to the water heater which can be terminated in a vertical or horizontal arrangement. See Figure 40 and Figure 41 on page 34.

DIRECT VENT CONFIGURATION

Direct Vent configurations derive all combustion air directly from the outdoor atmosphere through a sealed intake air pipe and discharge all flue gases to the outdoor atmosphere through a sealed vent (exhaust) pipe. Direct Vent configurations have two pipes connected to the water heater, one vent pipe and one intake air pipe. Direct Vent configurations can be terminated in one of six different arrangements. See Figure 42 on page 34 through Figure 47 on page 35.

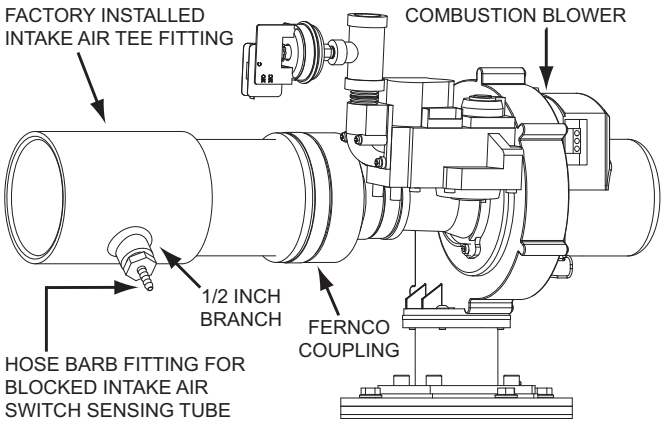
GENERAL VENTING INSTRUCTIONS

These instructions must be followed on all installations.

1. DO NOT install the water heater in a Power Vent configuration unless there is adequate supply of fresh air, see Air Requirements on page 18. If the installation space does not provide an adequate supply of fresh air the water heater must be installed in a Direct Vent configuration.
2. If the water heater is to be installed in a beauty shop, barber shop, cleaning establishment, a laundry with dry cleaning equipment or any space with contaminated air it is imperative that the water heater(s) be installed in a Direct Vent configuration so that all air for combustion is derived from the outdoor atmosphere.
3. The vent and intake air piping must terminate outdoors.
4. The minimum clearance from combustible materials for the vent (exhaust) and intake air piping shall be 0 inches. Vent piping passing through a combustible wall or ceiling must be a continuous run (no joints).
5. The water heater must be protected from freezing downdrafts during shutdown periods.
6. The vent (exhaust) pipe must not be combined or connected to any other appliance's vent system or chimney.
7. The intake air pipe must not be combined or connected to any other appliance's intake air piping.
8. Locate the water heater where the vent (exhaust) and intake air piping will remain within the maximum equivalent lengths allowed. See Venting Requirements on page 24.
9. Do not install the vent or intake air piping in a manner that will allow water to be trapped in the piping.
10. Vent pipes must be pitched a minimum of a 1/4 inch per foot back to the water heater (to allow drainage of condensate).
11. Do not anchor the vent or intake air pipe directly to framed walls, floors or ceilings unless rubber isolation pipe hangers are used to prevent vibration noise from being transmitted.
12. Use only approved vent/intake air pipe sizes and materials. See Venting Requirements on page 24.
13. Use only factory supplied vent and intake air or concentric terminations. See the Venting Requirements on page 24.
14. Do not locate the vent (exhaust) or intake air terminations where they would be objectionable due to noise at the termination(s). This includes locations close to or across from windows and doors.
15. Direct venting into dead air spaces such as alleys, atriums, and inside corners can cause recirculation of flue gases. Recirculation of flue gases will cause sooting, premature failure of the heat exchanger and icing of the combustion air intake during severe cold weather. To prevent the recirculation of flue gases, maintain as much distance as possible between the intake air and vent terminations.
16. Do not locate the vent termination over a public area where condensate or vapor can cause a nuisance or ice hazard.
17. Ensure the screens in the factory supplied terminations are securely installed to prevent blockage in the vent system.
18. Stress levels in pipe/fittings can be significantly increased by improper installation. If rigid pipe clamps are used to hold the pipe in place, or if the pipe cannot move freely through a wall penetration, the pipe may be stressed, or high thermal stresses may be formed when the pipe heats up and expands. Install accordingly to minimize such stresses.
19. Ensure the intake air connection Tee fitting is oriented properly on BTH 199/250 models, see page 23 for instructions.
20. Carefully read the Venting Requirements on page 24 and then proceed to the Venting Installation Sequence on page 25.

BTH 199 & BTH 250 INTAKE AIR CONNECTION

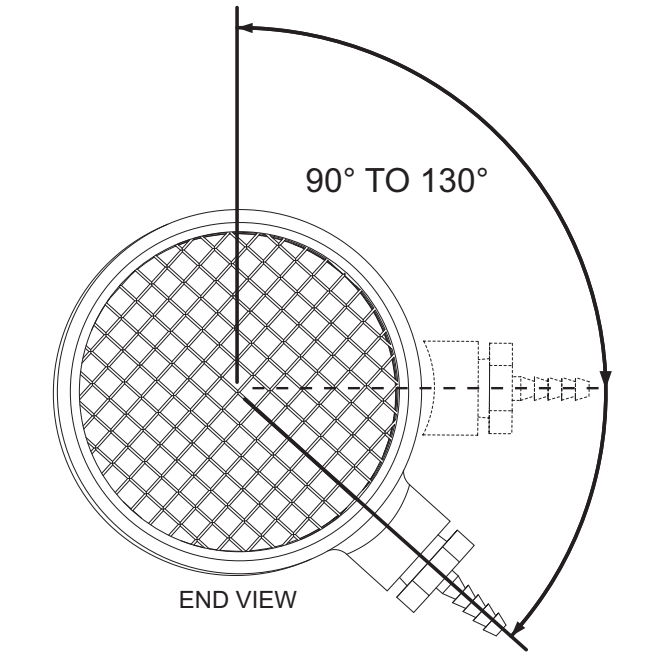
BTH 199 and BTH 250 models are factory equipped with a unique Combustion Blower and intake air connection Tee fitting. The Tee is a 3" x 3" x 1/2" fitting. The intake air connection Tee fitting has a hose barb installed in the 1/2 inch branch to connect the Blocked Intake Air switch sensing tube, see Figure 15.



COMBUSTION BLOWER ASSEMBLY
199,000 & 250,000 Btu/hr MODELS

Figure 15

Ensure the hose barb installed in the Tee fitting **IS NOT** facing down towards the ground (180° - 6 o'clock position) before venting installation begins. The barb fitting must be angled between 90° and no more than 130° as shown in Figure 16. If the barb fitting is facing down, residual condensate that occasionally forms in the intake air pipe can drain into the Blocked Intake Air switch through the attached sensing tube and damage the switch. This condition can also lead to Blocked Intake Air fault conditions and associated control system lock outs.



CORRECT ORIENTATION
INTAKE AIR TEE FITTING

Figure 16

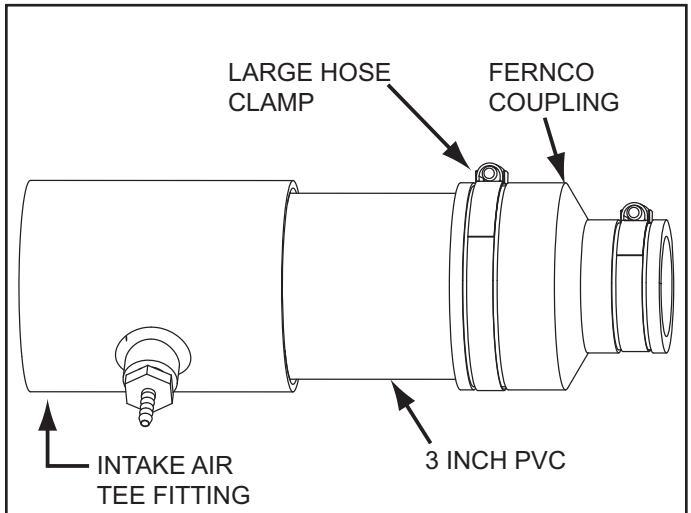
The intake air Tee fitting is factory installed with the 1/2 inch branch and hose barb angled to the right at approximately 130° when viewed from the end, see Figure 16. The Tee fitting's 1/2 inch branch and hose barb must not be angled any lower (towards the ground) than this factory specification. Angling higher, up to a 90° position, will not adversely affect operation and is acceptable.

INSPECT/ADJUST INTAKE AIR TEE FITTING

Inspect the angle of the Tee fitting's 1/2 inch branch and hose barb while viewing from the end of the Tee, see Figure 16. If the angle of the Tee fitting 1/2 inch branch and hose barb is lower than shown, adjustment will be necessary. To adjust the intake air Tee fitting angle follow the steps listed below.

Adjustment Procedure:

1. Ensure the water heater is turned off at the on/off switch on the front of the water heater.
2. Disconnect the Blocked Intake Air switch sensing tube, see Figure 4 on page 9 for location.
3. Loosen the large hose clamp on the Fernco coupling that connects the intake air connection pipe to the Combustion blower, see Figure 17.
4. Adjust the angle of the Tee fitting so that the 1/2 inch branch and hose barb are at the proper angle as shown in Figure 16.
5. Retighten the large hose clamp on the Combustion Blower intake air Fernco coupling,
6. Reconnect the Blocked Intake Air switch sensing tube making sure the sensing tube is securely connected at both ends and is not kinked.



INTAKE AIR CONNECTION PIPE
199,000 & 250,000 Btu/hr MODELS

Figure 17

VENTING REQUIREMENTS

APPROVED MATERIALS

Approved vent and intake air pipe materials that may be used in the United States:

- PVC Schedule 40 (ASTM D 2241 / CSA B181.2, ASTM D 1785 / CSA B137.3
- CPVC Schedule 40 (ASTM F-411 / CSA B137.6)
- ABS (ASTM D-2661)

Approved vent and intake air pipe materials that must be used in Canada:

- ULC S636 PVC / CPVC

FIELD SUPPLIED FITTINGS

Field supplied fittings should be equivalent to the piping material being installed. Field installed/supplied fittings will add equivalent feet to the vent or intake air piping as indicated below. All field supplied/installed fittings and piping must be factored into the equivalent feet calculations.

- 90° elbows (short or long radius) are equivalent to 5 linear feet (152 cm) of pipe.
- 45° elbows (short or long radius) are equivalent to 2.5 linear feet (76 cm) of pipe.

PRIMER AND CEMENT

Tetrahydrofuran (THF) primer should be used to prepare the surfaces of pipe and fittings for solvent welding. If CPVC or ABS pipe and fittings are used, then the proper cement must be used for all joints, including joining the pipe to the factory provided terminations (PVC material). PVC Materials should use ASTM D-2564 Grade Cement; CPVC Materials should use ASTM F-493 Grade Cement and ABS Materials should use ASTM D-2235 Grade Cement.

PIPE SIZE REQUIREMENTS

The water heaters covered in this manual are certified for the use of 3 and 4 inch pipe for the vent (exhaust) and intake air piping. If the installed equivalent length for the intake air or vent piping will be 50 feet (15.2 m) or less, 3 inch pipe must be used. If the installed equivalent length will be more than 50 feet (15.2 m), 4 inch pipe must be used.

NOTE: Install the pipe size required for the installed equivalent length of each pipe independently. IE: If the intake air pipe will be 50 equivalent feet or less and the vent pipe will more than 50 equivalent feet; the intake air pipe must be installed using 3 inch pipe and the vent must be installed using 4 inch pipe.

MAXIMUM EQUIVALENT LENGTHS

Three Inch Pipe

The water heaters covered in this manual are certified to a maximum length of 3 inch pipe for the exhaust venting arrangement of 50 equivalent feet (15.2 m). The certified maximum length of 3 inch pipe for intake air piping is also 50 equivalent feet (15.2 m). IE: On Direct Vent installations both pipes can be up to 50 equivalent feet (15.2 m).

Four Inch Pipe

The water heaters covered in this manual are certified to a maximum length of 4 inch pipe for the exhaust venting arrangement of 120 equivalent feet (36.5 m). The certified maximum length of 4 inch pipe for intake air piping is also 120 equivalent feet (36.5 m). IE: On Direct Vent installations both pipes can be up to 120 equivalent feet (36.5 m).

MINIMUM EQUIVALENT LENGTHS

Three Inch Pipe

The water heaters covered in this manual are certified to a minimum length of 3 inch pipe for the vent (exhaust) of 7 equivalent feet (2.1 m). There is no minimum equivalent feet requirement for the intake air pipe.

Four Inch Pipe

The water heaters covered in this manual are certified to a minimum length of 4 inch pipe for the vent (exhaust) of 50 equivalent feet (15.2 m). There is no minimum equivalent feet requirement for the intake air pipe.

MAXIMUM NUMBER OF ELBOWS

Three Inch Pipe

The vent pipe may have a maximum of four 90° elbows installed when 3 inch pipe is being used. The intake air pipe may also have a maximum of four 90° elbows installed. IE: in a Direct Vent configuration each pipe can have up to four 90° elbows installed.

Four Inch Pipe

The vent pipe may have a maximum of six 90° elbows installed when 4 inch pipe is being used. The intake air pipe may also have a maximum of six 90° elbows installed. IE: in a Direct Vent configuration each pipe can have up to six 90° elbows installed.

FACTORY SUPPLIED FITTINGS

The water heater ships with two (2) factory supplied 3 inch terminations (PVC 45° elbows with debris screen). Factory supplied vent and intake air terminations or concentric terminations must be used. Factory supplied terminations and installed fittings (exhaust elbow and intake air connection) add zero equivalent feet to the vent and intake air piping.

TABLE 7

Number of 90° Elbows Installed	3 Inch Pipe	4 Inch Pipe
	Maximum Feet (Meters)	Maximum Feet (Meters)
One (1)	45 feet (13.7 meters)	115 feet (35.0 meters)
Two (2)	40 feet (12.2 meters)	110 feet (33.5 meters)
Three (3)	35 feet (10.7 meters)	105 feet (32.0 meters)
Four (4)	30 feet (9.1 meters)	100 feet (30.5 meters)
Five (5)	N/A	95 feet (29.0 meters)
Six (6)	N/A	90 feet (27.4 meters)

4 INCH EXTENDED VENT TERMINATIONS

When 4 inch intake air or vent pipe is installed, factory supplied 4 inch terminations must be used. Contact your local distributor or call the parts department (phone number listed on the back cover of this manual) to order 4 inch termination(s).

OPTIONAL CONCENTRIC TERMINATIONS

The water heaters covered by this manual may be installed in a Direct Vent configuration using a 4 inch concentric termination.

Concentric terminations must be ordered separately. Contact your local distributor or call the parts department phone number listed on the back cover of this manual to order.

Concentric Vent Termination Part Numbers:

- 4” Concentric Termination # 9006328005

VENTING INSTALLATION SEQUENCE

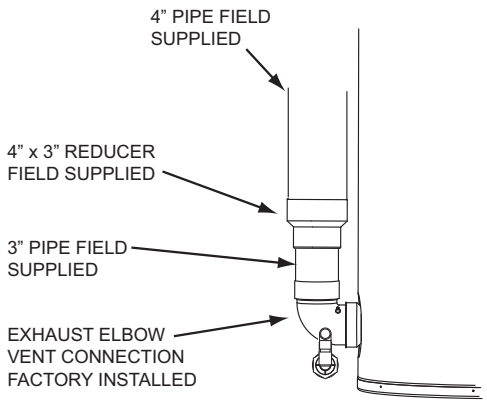
1. Read the General Venting Instructions on page 22 and Venting Requirements on page 24 before proceeding. These instructions and requirements must be followed on all installations.
2. Determine whether the water heater will be installed in a Power Vent or Direct Vent configuration and which vent system arrangement will be used for the installation. See the various venting arrangements on pages 34 and 35.
3. Proceed to the applicable instructions:
   - Power Vent Installation on page 25.
   - Direct Vent Installation on page 25.

POWER VENT INSTALLATION

1. Read the General Venting Instructions on page 22 and Venting Requirements on page 24 before proceeding. These instructions and requirements must be followed in addition to the instructions below that are specific for Power Vent configurations.
2. Determine which Power Vent arrangement will be used for the installation; vertical or horizontal termination. See Figure 40 and Figure 41 on page 34.
3. Determine the vent pipe size for the installation, see Venting Requirements on page 24.
4. Plan the layout of the vent piping backwards from the termination point outdoors to the water heater. Layout the vent piping to use a minimum of pipe and elbows.
5. Install the termination first.

   If the vent piping will terminate vertically, through a roof, see Vertical Termination Installation on page 27.

   If the vent piping will terminate horizontally, through a sidewall, see Sidewall Termination Installation on page 29.
6. When installation of the termination is complete install necessary piping and fittings to route the vent piping back to the water heater.
7. The vent pipe must be supported properly to avoid bending or failure. The water heater manufacturer recommends that the vent pipe be supported every 5 feet (152 cm) of vertical run and every 3 feet (91 cm) of horizontal run.
8. Do not install the vent piping in a manner that will allow water to be trapped in the piping.


4" PIPE FIELD SUPPLIED
4" x 3" REDUCER FIELD SUPPLIED
3" PIPE FIELD SUPPLIED
EXHAUST ELBOW VENT CONNECTION FACTORY INSTALLED

VENT (EXHAUST) CONNECTION

Figure 18

9. All vent (exhaust) pipes must be pitched a minimum of a 1/4 inch per foot back to the water heater (to allow drainage of condensate).
10. If installing 3 inch vent pipe connect the vent pipe to the exhaust elbow on the water heater.
11. If installing 4 inch pipe transition to 3 inch pipe at the exhaust elbow on the water heater as shown in Figure 18. The field installed 3" pipe between the exhaust elbow and the 4" x 3" reducer coupling should be 18 inches (45 cm) or less in length.

DIRECT VENT INSTALLATION

1. Read the General Venting Instructions on page 22 and Venting Requirements on page 24 before proceeding. These instructions and requirements must be followed in addition to the instructions below that are specific for Direct Vent configurations.
2. Determine which Direct Vent arrangement will be used for the installation. There are six (6) Direct Vent arrangement options. See Figure 42 & Figure 43 on page 34 and Figure 44 through Figure 47 on page 35.
3. Determine vent and intake air pipe size to be used for the installation; see Venting Requirements on page 24.
4. Plan the layout of the vent and intake air piping backwards from the termination point outdoors to the water heater. Layout the vent and intake air piping to use a minimum of pipe and elbows.
5. Install the terminations first.

   If standard terminations are being used and the intake air or vent piping will terminate vertically, through a roof, see Vertical Termination Installation on page 27.

   If standard terminations are being used and the intake air or vent piping will terminate horizontally, through a sidewall, see Sidewall Termination Installation on page 29.

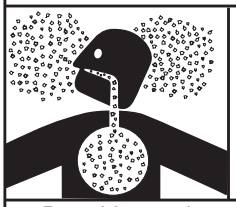
   If a concentric termination(s) will be used see Concentric Termination Installation on page 30.
6. When installation of the termination(s) is complete Install necessary piping and fittings to route the intake air and vent piping back to the water heater.
7. The intake air and vent piping must be supported properly to avoid bending or failure. The water heater manufacturer recommends that the vent and intake air piping be supported every 5 feet (152 cm) of vertical run and every 3 feet (91 cm) of horizontal run.
8. Do not install the vent or intake air piping in a manner that will allow water to be trapped in the piping.
9. A field supplied condensate Tee fitting and drain hose should be installed in the intake air piping near the water heater in colder climates with heavy snow accumulations and in areas that regularly experience high humidity. The drain hose should be routed to an adequate floor drain separate from any other condensate drains. See Figure 21 on page 26.

   NOTE: Snow being pulled into the intake air piping and then melting can lead to excessive amounts of water accumulation and damage water heater components. Warm, humid outdoor air can lead to excessive condensation inside the intake air piping and may also damage water heater components.
10. The intake air and vent (exhaust) piping must be pitched a minimum of a 1/4 inch per foot back to the water heater (to allow drainage of condensate).

11. If installing 3 inch vent pipe connect the vent pipe to the exhaust elbow on the water heater.
12. If installing 4 inch vent pipe transition to 3 inch pipe at the exhaust elbow on the water heater as shown in Figure 18 on page 25. The field installed 3" pipe between the exhaust elbow and the 4" x 3" reducer coupling should be 18 inches (45 cm) or less in length.
13. Ensure the Intake Air Screen on the Intake Air Connection to the water heater is removed before connecting the intake air pipe to the water heater. See Figure 19.

⚠ WARNING

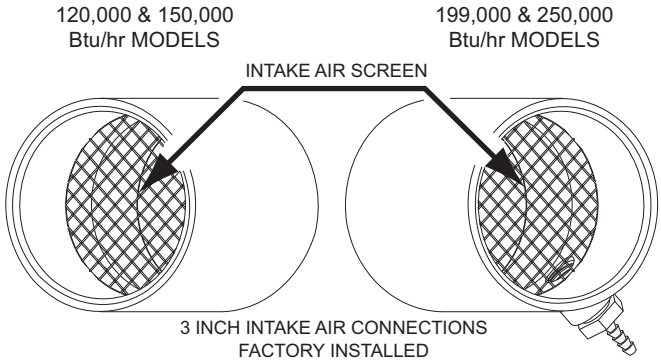
Breathing Hazard - Carbon Monoxide Gas



- Do not obstruct water heater air intake.
- Gas and carbon monoxide detectors are available.
- Install water heater in accordance with the instruction manual.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

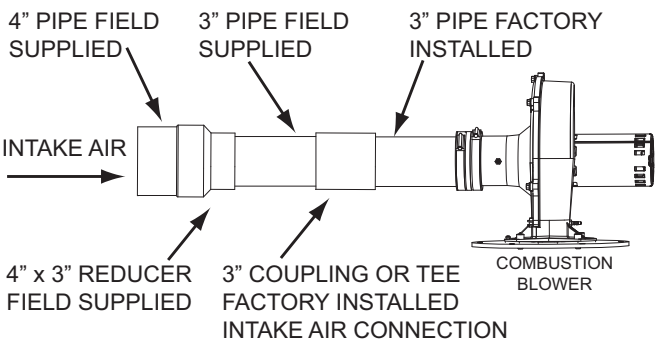
NOTE: Do not leave the screen inside the Intake Air Connection for Direct Vent installations. Once the intake air pipe is installed the screen will be hidden from view and may become clogged with debris over time. This will cause improper combustion and may also lead to Blocked Intake Air fault conditions and associated control system lock outs.



INTAKE AIR SCREEN
(remove for Direct Vent)

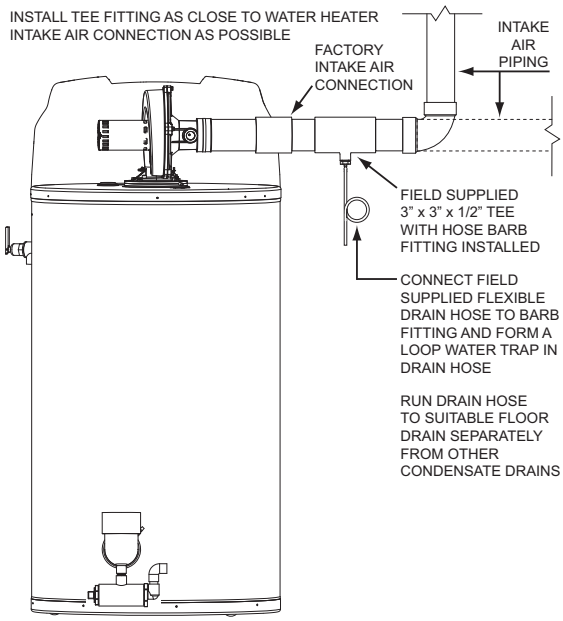
Figure 19

14. If installing 3 inch intake air pipe connect the intake air pipe to the intake air connection on the water heater.
15. If installing 4 inch intake air pipe transition to 3 inch pipe at the intake air connection on the water heater as shown in Figure 20. The field installed 3" pipe between the intake air connection and the 4" x 3" reducer coupling should be 18 inches (45 cm) or less in length.


4" PIPE FIELD SUPPLIED
3" PIPE FIELD SUPPLIED
3" PIPE FACTORY INSTALLED
INTAKE AIR
4" x 3" REDUCER FIELD SUPPLIED
3" COUPLING OR TEE FACTORY INSTALLED INTAKE AIR CONNECTION
COMBUSTION BLOWER

INTAKE AIR CONNECTION

Figure 20


INSTALL TEE FITTING AS CLOSE TO WATER HEATER INTAKE AIR CONNECTION AS POSSIBLE
FACTORY INTAKE AIR CONNECTION
INTAKE AIR PIPING
FIELD SUPPLIED 3" x 3" x 1/2" TEE WITH HOSE BARB FITTING INSTALLED
CONNECT FIELD SUPPLIED FLEXIBLE DRAIN HOSE TO BARB FITTING AND FORM A LOOP WATER TRAP IN DRAIN HOSE
RUN DRAIN HOSE TO SUITABLE FLOOR DRAIN SEPARATELY FROM OTHER CONDENSATE DRAINS

INTAKE AIR CONDENSATE TEE INSTALLATION

Figure 21

VERTICAL TERMINATION INSTALLATION

1. Determine the location for the termination(s).

   NOTE: The standard vent and intake air terminations are of different design, see Figure 22.

2. If installing only the vent (exhaust) piping in a Power Vent configuration vertically through the roof; ensure that all exterior vertical clearance requirements shown in Figure 23 and Figure 24 on page 28 are being maintained. These clearances and those cited by local and national codes must be maintained.

   NOTE: On flat roof installations the vent termination must be a minimum of 24 inches (60 cm) above any parapet, vertical wall or structure within 10 feet (3 m) horizontally. See Figure 24 on page 28.

3. If installing both intake air and vent piping in a Direct Vent configuration vertically through the roof; ensure that all exterior vertical clearance requirements shown in Figure 23 and Figure 24 on page 28 are being maintained. These clearances and those cited by local and national codes must be maintained.

   NOTE: On flat roof installations the intake air and the vent terminations must be a minimum of 24 inches (60 cm) above any parapet, vertical wall or structure within 10 feet (3 m) horizontally. See Figure 24 on page 28.

4. If installing only vent piping in a Power Vent configuration vertically through the roof the following instructions must be followed:

   The vent termination must be oriented facing downward as shown in Figure 23 and Figure 24 on page 28.

   The bottom edge of the vent termination must be a minimum of 12 inches (30 cm), 18 inches (45 cm) in Canada, above the average or expected snow level as shown in Figure 23 on page 28.

5. If installing both intake air and vent piping in a Direct Vent configuration vertically through the roof the following instructions must be followed:

   The intake air and vent pipes must penetrate the same side of the roof as shown in Figure 25 on page 28.

   The intake air and vent terminations must be oriented facing downward and in the same direction as shown in Figure 25 on page 28.

   The intake air and vent terminations must have a minimum separation of 24" (61 cm) measured on center line as shown in Figure 25 on page 28. In colder climates this separation should be increased to at least 48 inches (122 cm).

   The bottom edge of the intake air and vent terminations must be a minimum of 12 inches (30 cm), 18 inches (45 cm) in Canada, above the average or expected snow level as shown in Figure 23 and Figure 25 on page 28.

6. When the intake air and/or vent piping from multiple water heaters will terminate in the same location the vent terminations can be grouped together in close proximity 0 inches/touching. Intake air terminations can also be grouped together in close proximity 0 inches/touching.

   The distance between the closest vent and intake air terminations must be a minimum of 24 inches (61 cm) as shown in Figure 25 on page 28. In colder climates this separation should be increased to at least 48 inches (122 cm).

7. Cut a 4 inch (10 cm) diameter hole for 3 inch pipe or 5 inch (13 cm) diameter hole for 4 inch pipe where the pipe(s) will pass through the roof.

   NOTE: Beware of concealed wiring and piping when cutting through the roof.

8. Suspend the pipe(s) through center of hole using field supplied metal strapping or equivalent support materials as shown in Figure 23 on page 28.

9. Slide a roof boot or equivalent flashing over the pipe and secure roof boot or equivalent flashing to roof and seal around the flashing as shown in Figure 23, Figure 24 and Figure 25 on page 28.

10. Install the factory supplied intake air and/or vent termination(s) using field supplied pipe and one field supplied 90° elbow as shown in Figure 23 on page 28. The short section of pipe that connects between the field supplied 90° elbow and the factory supplied termination must not be excessive in length. The exposed portion of this pipe shall be no more than 2 inches (5 cm), see Figure 23 on page 28.

11. Return to Power Vent Installation on page 25 or Direct Vent Installation on page 25 to complete the installation of the intake air and/or vent piping between the termination(s) and the water heater.

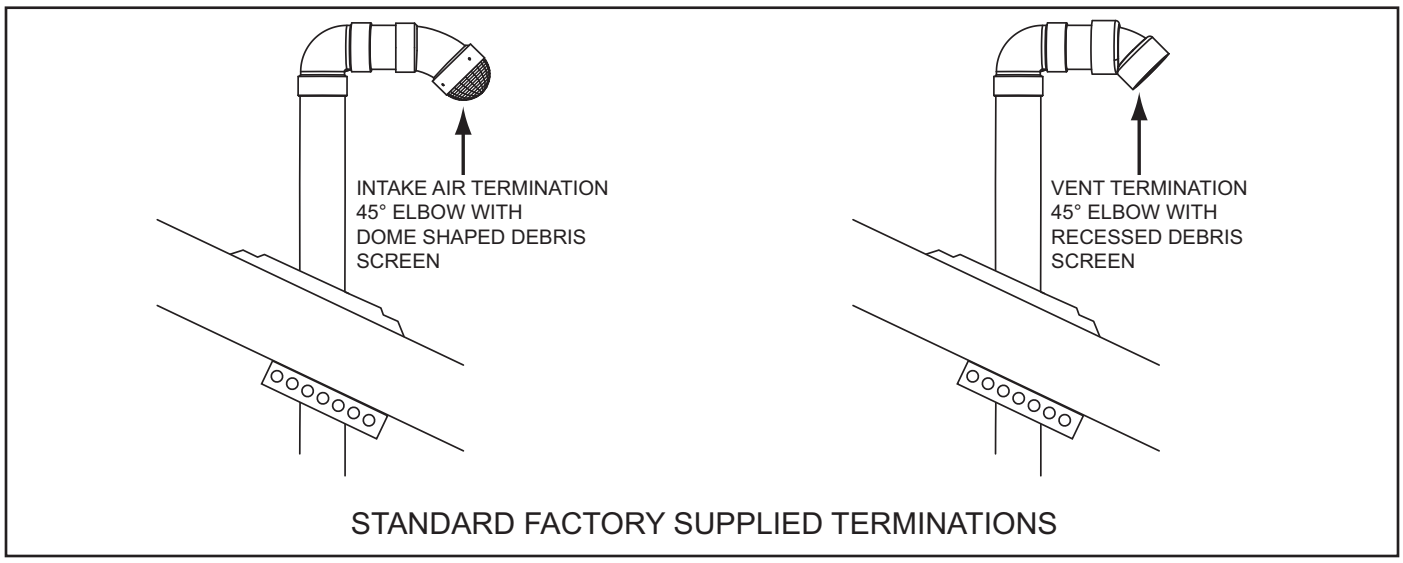
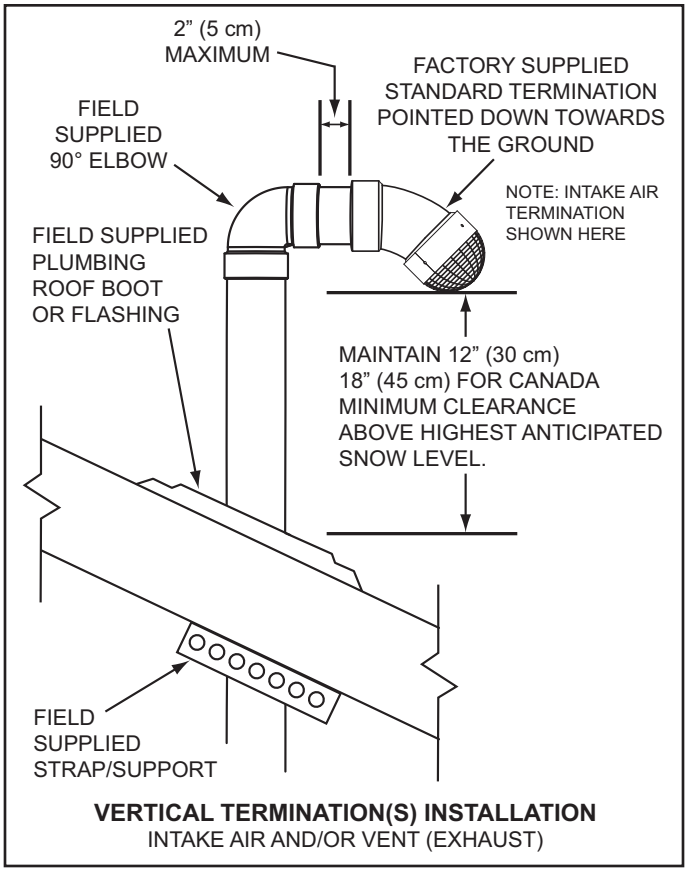
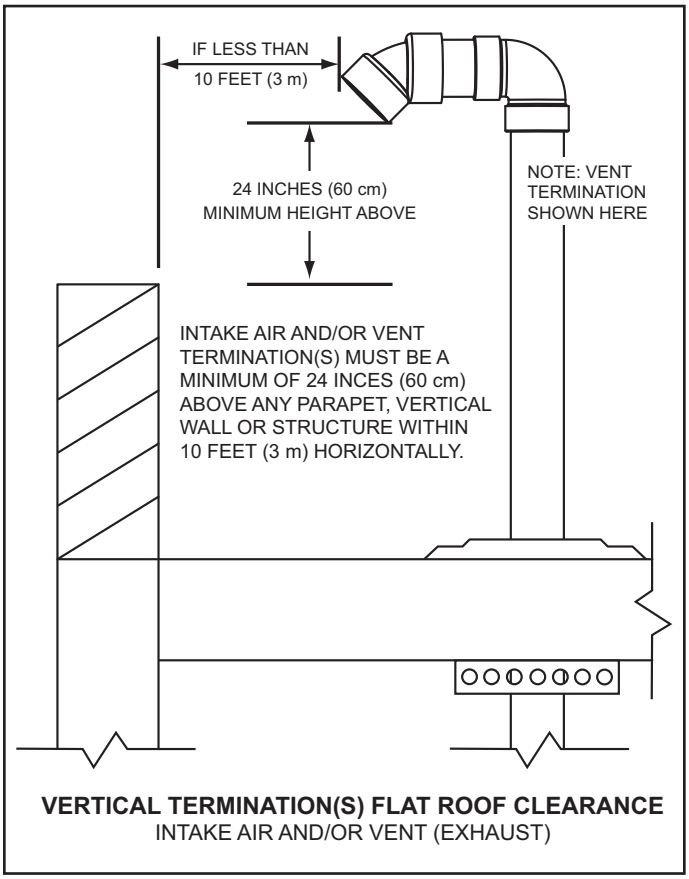


Figure 22



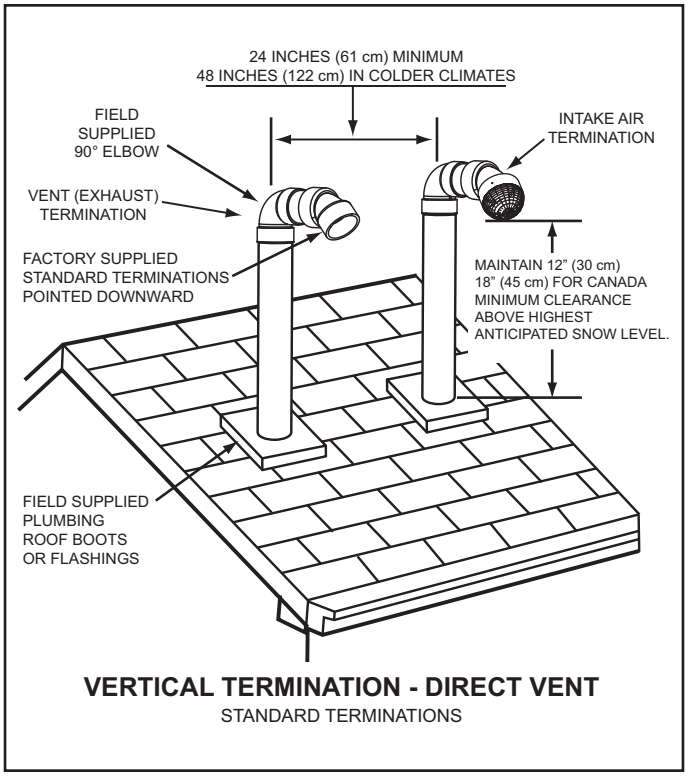
VERTICAL TERMINATION(S) INSTALLATION
INTAKE AIR AND/OR VENT (EXHAUST)

Figure 23



VERTICAL TERMINATION(S) FLAT ROOF CLEARANCE
INTAKE AIR AND/OR VENT (EXHAUST)

Figure 24



VERTICAL TERMINATION - DIRECT VENT
STANDARD TERMINATIONS

Figure 25

SIDEWALL TERMINATION INSTALLATION

1. Determine the location for the termination(s).

   NOTE: The standard vent and intake air terminations are of different design, see Figure 22 on page 27.

2. If installing only vent (exhaust) piping in a Power Vent configuration through a sidewall; ensure that all exterior sidewall clearance requirements for the termination, shown in Figure 48 on page 36, are being maintained. These clearances and those cited by local and national codes must be maintained.

3. If installing both intake air and vent piping in a Direct Vent configuration through a sidewall; ensure that all exterior sidewall clearance requirements for the terminations, shown in Figure 49 on page 37, for the vent and intake air termination are being maintained. These clearances and those cited by local and national codes must be maintained.

4. If installing both an intake air and vent termination in a Direct Vent configuration through a sidewall there must be a minimum of 24 inches (61 cm) separation, measured on vertical center line, between the intake air and vent terminations, see Figure 26.

   NOTE: In colder climates this separation should be increased to at least 48 inches (122 cm) between the intake air and vent termination or any other appliance vent that discharges moisture-laden air such as clothes dryers. This will reduce possibility of frost over from side winds blowing exhaust vapors to the intake air termination and is recommended for Canadian installations.

5. If installing both intake air and vent terminations in a Direct Vent configuration through a sidewall the intake air and vent terminations must be installed at the same elevation measured on horizontal center line - see Figure 26.

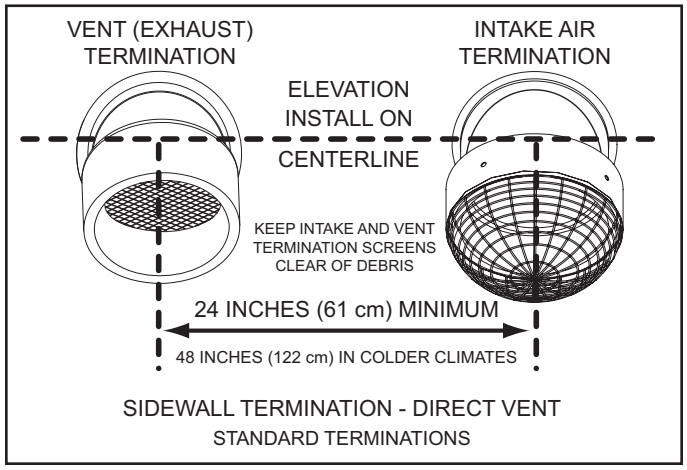

VENT (EXHAUST) TERMINATION
INTAKE AIR TERMINATION
ELEVATION INSTALL ON CENTERLINE
KEEP INTAKE AND VENT TERMINATION SCREENS CLEAR OF DEBRIS
24 INCHES (61 cm) MINIMUM
48 INCHES (122 cm) IN COLDER CLIMATES
SIDEWALL TERMINATION - DIRECT VENT
STANDARD TERMINATIONS

Figure 26

6. When the intake air and/or vent piping from multiple water heaters will terminate at the same location through a sidewall, the vent terminations can be grouped together in close proximity - 0 inches/touching. The intake air terminations can also be grouped together in close proximity - 0 inches/touching.

   However, the distance between the closest vent and intake air terminations must be a minimum of 24 inches (61 cm). In colder climates this separation should be increased to at least 48 inches (122 cm). See Figure 26.

7. Cut a 4 inch (10 cm) diameter hole for 3 inch pipe or 5 inch (13 cm) diameter hole for 4 inch pipe where the pipe(s) will pass through the wall.

   NOTE: Beware of concealed wiring and piping when cutting through the wall.

8. Cut a length(s) of pipe being installed 3.5 inches (8.9 cm) to 9.5 inches (24.1 cm) longer than the wall thickness at the opening. See Figure 27.

   NOTE: Vent Termination – exhaust gases of this water heater are less than 140°F. In cold climates water vapor in the exhaust gases will condense into a cloud of vapor where the vent exits the building. This vapor can gradually discolor exterior building surfaces. The vent termination should be located where this vapor cloud and potential discoloration are not a concern. Extending the exposed vent piping up to a maximum of 6 inches (15.2 cm) from the wall helps vapor from being trapped along a building's face. To avoid this problem, the vent can also be terminated vertically through the roof, see Vertical Termination Installation on page 27.

9. Cement the intake air and/or vent termination to the section(s) of pipe cut to length in the above Step.

10. Slide the included metal wall plate(s) over the pipe(s) to stop against the intake air and/or vent termination. Place some silicone caulking (field supplied) on the back of the wall plate(s) to secure it to the wall.

11. Working from outside, slide the pipe and termination(s) assembled in the above steps through the wall. Ensure the termination(s) is pointed down towards the ground. See Figure 27.

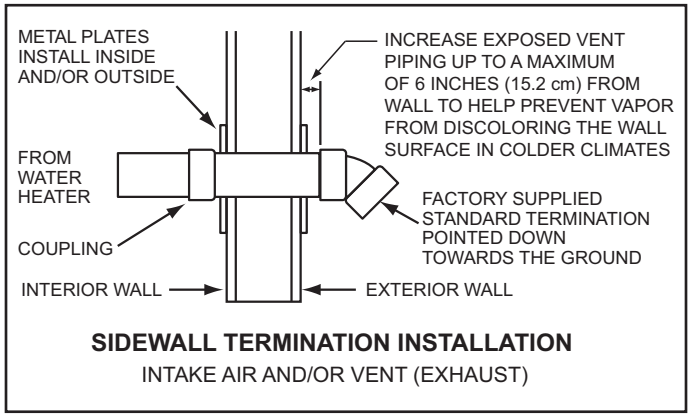

METAL PLATES INSTALL INSIDE AND/OR OUTSIDE
INCREASE EXPOSED VENT PIPING UP TO A MAXIMUM OF 6 INCHES (15.2 cm) FROM WALL TO HELP PREVENT VAPOR FROM DISCOLORING THE WALL SURFACE IN COLDER CLIMATES
FROM WATER HEATER
FACTORY SUPPLIED STANDARD TERMINATION POINTED DOWN TOWARDS THE GROUND
COUPLING
INTERIOR WALL
EXTERIOR WALL
SIDEWALL TERMINATION INSTALLATION
INTAKE AIR AND/OR VENT (EXHAUST)

Figure 27

12. Place a bead of silicone caulking (field supplied) around the gap between the installed pipe(s) and the wall. Apply enough to fill the gap between the pipe(s) and wall.

13. Press the wall plate flush against the outside wall.

14. Working from the inside apply enough silicone caulking on the back of the interior wall plate(s) to hold it in place and slide the wall plate over the installed pipe(s).

15. Install a coupling to the end of the pipe(s) inside the building. Before the silicone caulking has time to completely set go outside the building and ensure the termination(s) is still pointing down towards the ground. See Figure 27.

16. Return to Power Vent Installation on page 25 or Direct Vent Installation on page 25 to complete the installation of the intake air and/or vent piping between the termination(s) and the water heater.

CONCENTRIC TERMINATION INSTALLATION

1. Concentric terminations must be ordered separately. BTH 120 - 250 models must use the 4 inch concentric termination; Part Number: 9006328005. Contact your local distributor or call the parts department phone number on the back cover of this manual to order concentric terminations.
2. Determine the location for the termination.

   NOTE: Roof termination is preferred since it is less susceptible to damage, has reduced chances to intake contaminants and vent vapors are less visible.
3. When installing a concentric termination vertically through the roof; ensure that all exterior vertical clearance requirements for the concentric termination, shown in Figure 30 on page 31 are being maintained. These clearances and those cited by local and national codes must be maintained.
4. When installing a concentric termination vertically through a flat roof, the termination's vent cap must be a minimum of 10 feet (3 m) away from any parapet, vertical wall or structure as shown in Figure 28.

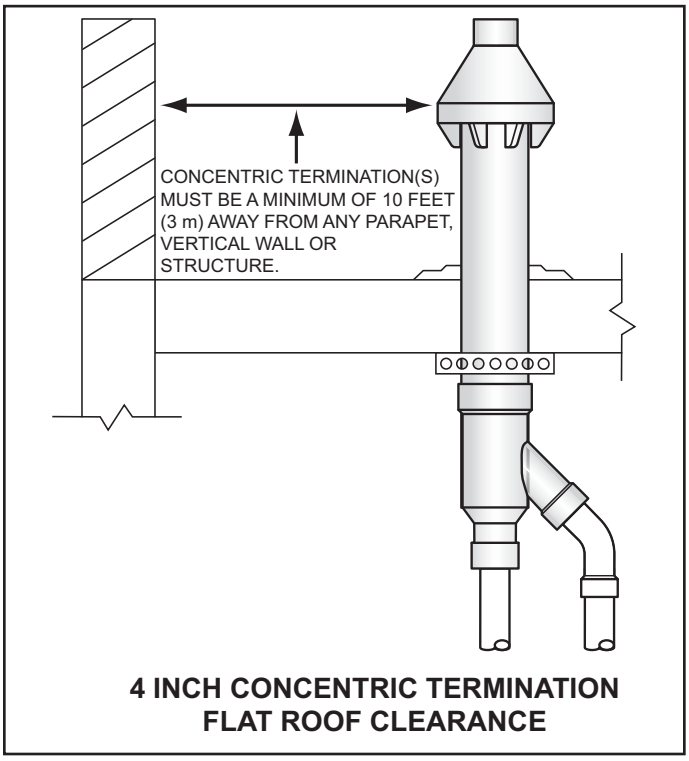


Figure 28

   NOTE: If this required 10 foot (3 m) distance to a parapet, vertical wall or structure cannot be maintained, standard terminations must be used. See Vertical Termination Installation on page 27.
5. When installing a concentric termination through a sidewall; ensure that all exterior sidewall clearance requirements for the termination, shown in Figure 49 on page 37, are being maintained. These clearances and those cited by local and national codes must be maintained.
6. When installing multiple concentric terminations vertically through a roof or horizontally through a sidewall ensure the required clearances between terminations and groupings of multiple terminations are maintained. See pages 32 and 33 for more information.
7. Cut a 5 inch (13 cm) diameter hole for the 4 inch concentric termination where the termination will pass through the wall or roof.

   NOTE: Beware of concealed wiring and piping when cutting through the wall or roof.
8. When installing multiple concentric terminations vertically through the roof in the same location the termination caps for all concentric terminations must be at the same height measured from ground. See Multiple Concentric Termination Arrangements on page 33.
9. Determine if the concentric termination will need to be shortened or lengthened to accommodate required clearances or to ensure all vent caps are at the same height when installing multiple terminations vertically through the roof in the same location.

   See Figure 29 on page 31 for the maximum and minimum lengths allowed for the 4 inch concentric termination.

   When extending the length of a concentric termination **DO NOT** use couplings. The use of couplings will restrict flow through the termination and may cause improper combustion. The termination's intake air and vent pipes must be replaced with longer sections of the same pipe material when extending the length of the termination.

   Use only SDR-26 pipe to extend the 4 inch concentric termination.

   When shortening the length of the termination carefully measure and cut the larger (intake air) pipe first. Cut the same amount of pipe off of the smaller (vent) pipe.
10. Proceed to 4 Inch Concentric Termination Installation on page 31.

4 INCH CONCENTRIC TERMINATION INSTALLATION

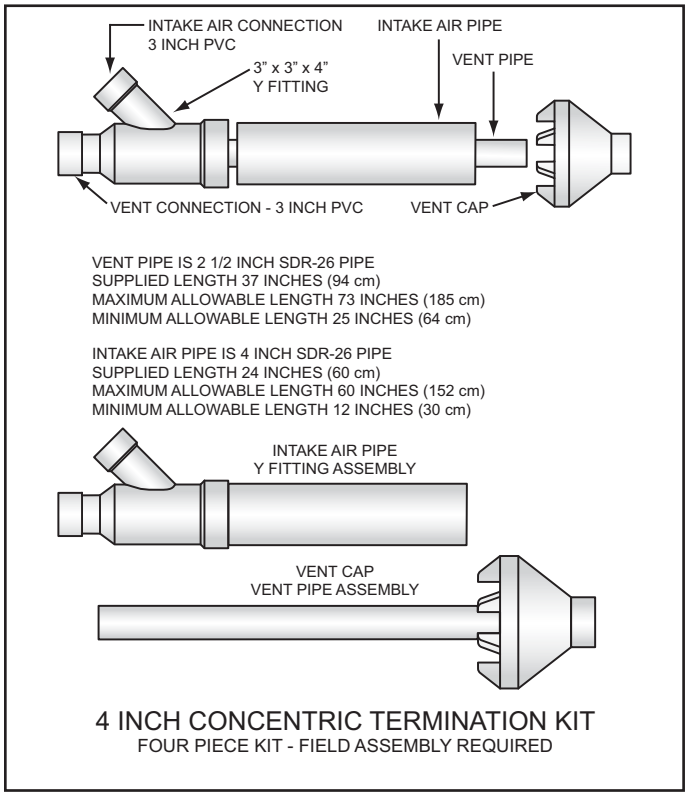

INTAKE AIR CONNECTION
3 INCH PVC
INTAKE AIR PIPE
VENT PIPE
3" x 3" x 4"
Y FITTING
VENT CONNECTION - 3 INCH PVC
VENT CAP
VENT PIPE IS 2 1/2 INCH SDR-26 PIPE
SUPPLIED LENGTH 37 INCHES (94 cm)
MAXIMUM ALLOWABLE LENGTH 73 INCHES (185 cm)
MINIMUM ALLOWABLE LENGTH 25 INCHES (64 cm)
INTAKE AIR PIPE IS 4 INCH SDR-26 PIPE
SUPPLIED LENGTH 24 INCHES (60 cm)
MAXIMUM ALLOWABLE LENGTH 60 INCHES (152 cm)
MINIMUM ALLOWABLE LENGTH 12 INCHES (30 cm)
INTAKE AIR PIPE
Y FITTING ASSEMBLY
VENT CAP
VENT PIPE ASSEMBLY
4 INCH CONCENTRIC TERMINATION KIT
FOUR PIECE KIT - FIELD ASSEMBLY REQUIRED

Figure 29

Assemble and install the 4 inch concentric termination. Refer to Figure 29, Figure 30 and Figure 31 for these instructions:

1. Cement the Y fitting to the larger diameter intake air pipe.
2. Slide the intake air pipe and Y fitting assembly from inside the building through the hole cut for the termination in the roof or sidewall. Ensure no foreign materials such as insulation accumulate inside the assembly.
3. Secure the intake air Y fitting assembly using field supplied metal strapping or equivalent support materials.
4. On installations installed through the roof slide a field supplied plumbing boot or roof flashing over the intake air Y fitting assembly and secure it to the roof.
5. Seal around the plumbing boot or roof flashing.
6. Cement the vent cap onto the vent pipe. Alternately a field-supplied stainless steel screw may be used to secure the 2 components together when field disassembly is desired for cleaning. A pilot hole must be drilled for the screw to prevent damage/cracking of the vent cap and/or vent pipe.
7. Install the vent cap/vent pipe assembly into the intake air Y fitting assembly, Ensure small diameter vent pipe is cemented and bottomed in the Y fitting.
8. When installing 3 inch intake air and vent piping connect and cement the pipe directly to the concentric termination. When installing 4 inch intake air and vent pipe - connect the piping to the concentric termination using field supplied 4" x 3" reducer couplings and short sections of 3 inch pipe (18 inches or less) pipe. Cement all fittings and pipe in place.
9. Return to Direct Vent Installation on page 25 to complete the installation of the intake air and vent piping between the concentric termination and the water heater.

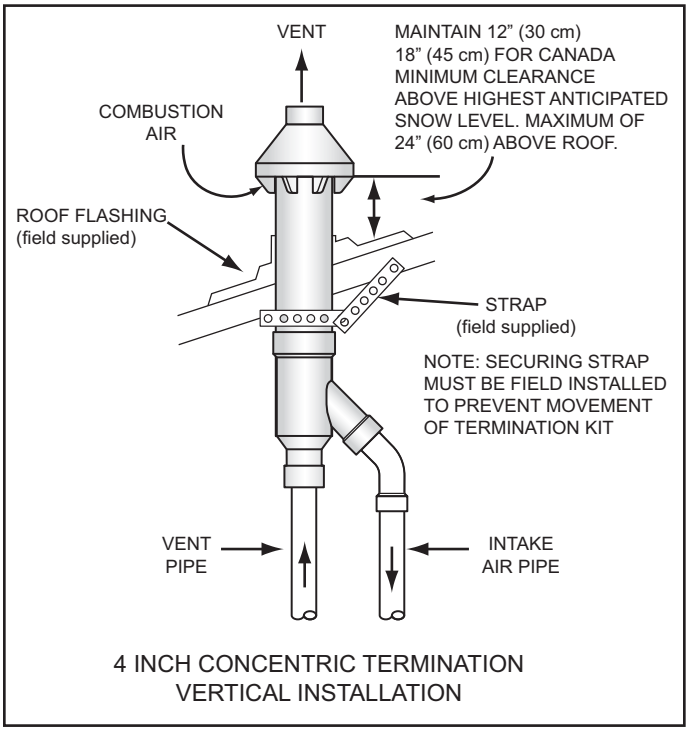


Figure 30

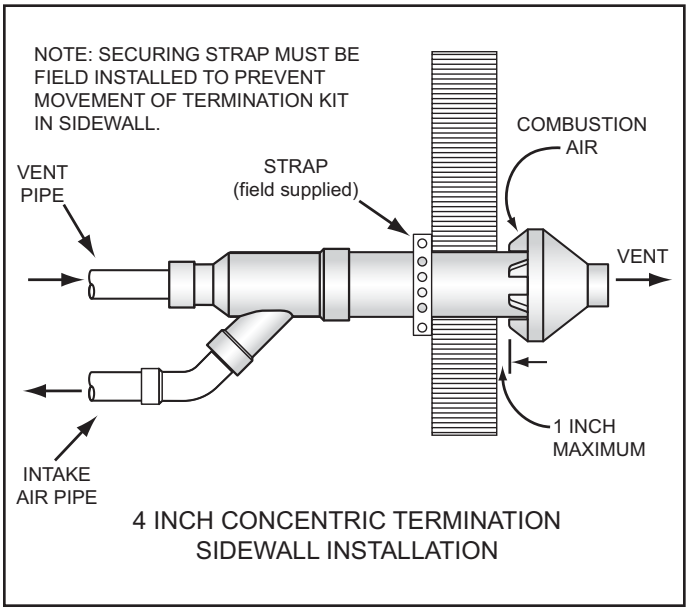


Figure 31

MULTIPLE CONCENTRIC TERMINATION CLEARANCES

When installing multiple concentric terminations vertically through a roof or horizontally through a sidewall ensure the required clearances (separation) between terminations are maintained. Ensure multiple terminations are arranged or grouped as required.

NOTE: These clearances must be maintained to prevent the recirculation of vent (exhaust) gases to the intake air. Clearances are measured between the edges of the concentric termination caps.

When installing multiple concentric terminations through a roof or through a sidewall the clearances shown in Figure 32 must be maintained.

See Multiple Concentric Termination Arrangements on page 33.

Close Proximity & Standard Clearance

1. The clearance between multiple termination caps must be 0 inches (touching) to a maximum of 2 inches (5 cm), dimension A - Figure 32, when installing concentric terminations in close proximity. See Figure 37 on page 33.
2. The clearance between multiple termination caps must be increased to a minimum of 24 inches (61 cm), dimension B - Figure 32, when installation in close proximity (above) is not possible. This is the standard clearance.

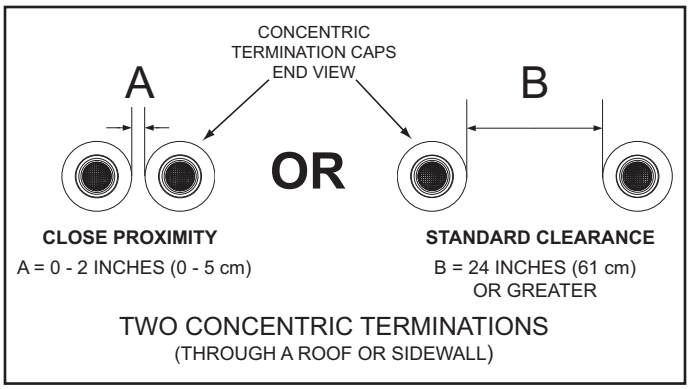


Figure 32

Three Concentric Terminations

1. When installing three concentric terminations through a roof or through a sidewall the third termination may be installed in close proximity as indicated by dimension A in Figure 33.
2. If close proximity installation of the third termination is not possible the third termination may be installed as indicated by dimension B in Figure 33.

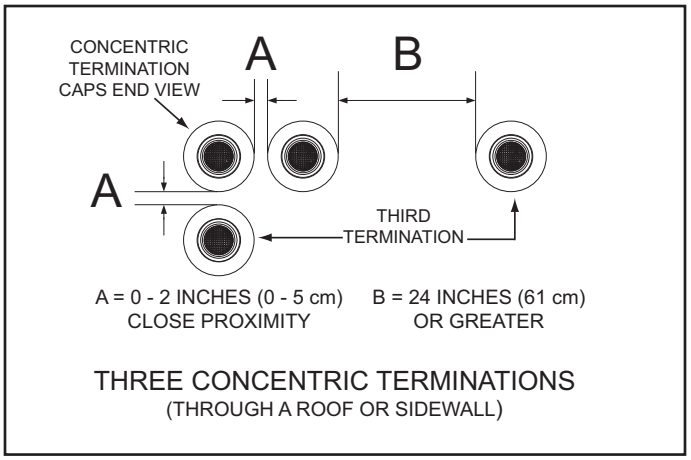


Figure 33

Four Concentric Terminations

1. When installing four concentric terminations through a roof or through a sidewall in close proximity they may be arranged into stacked rows of two as shown in Figure 34 or lateral rows of two as shown in Figure 35.
2. Four is the maximum number of concentric terminations that may be installed in a group where all terminations are in close proximity as shown in Figure 34.

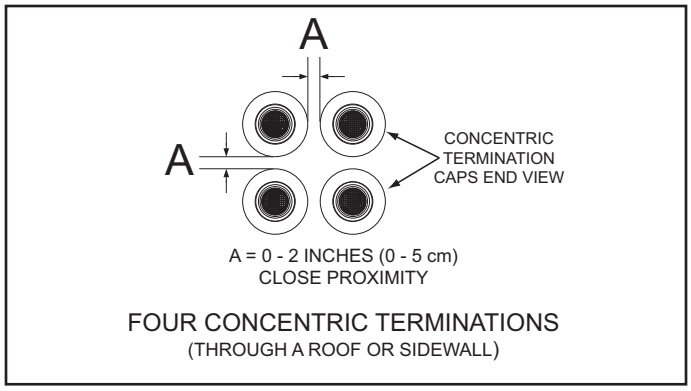


Figure 34

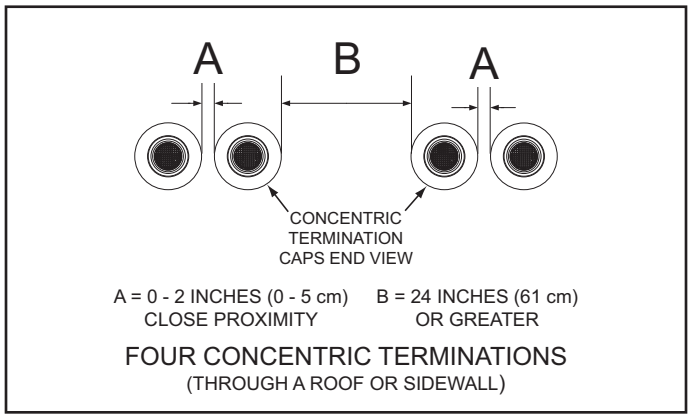


Figure 35

Groups Of Terminations

1. When installing multiple groups of concentric terminations through a roof or through a sidewall in close proximity they can be installed into stacked groups of four as shown in Figure 36. Lateral groups of four as shown in Figure 35 may be a more convenient installation arrangement for multiple groups depending on available space.

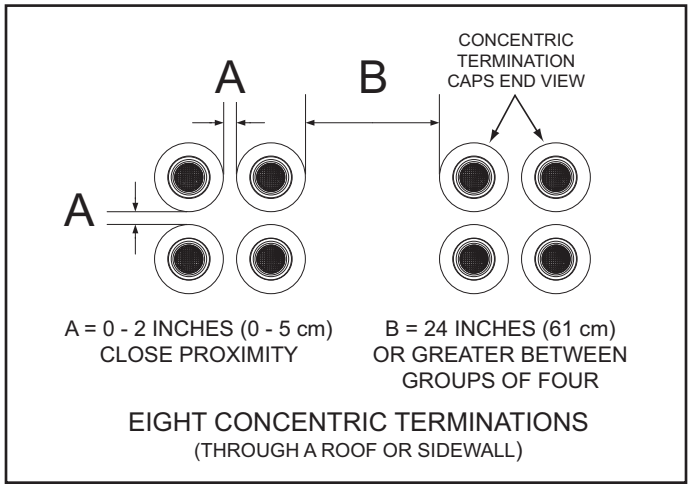


Figure 36

MULTIPLE CONCENTRIC TERMINATION ARRANGEMENTS

The illustrations on this page show some of the installation arrangements for multiple concentric terminations that are allowed.

See Multiple Concentric Termination Clearances on page 32 for detailed information on clearances and additional arrangement options.

NOTE: When multiple concentric terminations are installed through a roof in the same location all termination caps must be at the same height measured from the ground.

Two Concentric Terminations

Two concentric terminations may be installed in close proximity as shown in Figure 37 or with standard clearances when this arrangement is not possible. See Figure 32 on page 32 for detailed information on clearances. See Figure 33 on page 32 when installing three concentric terminations.

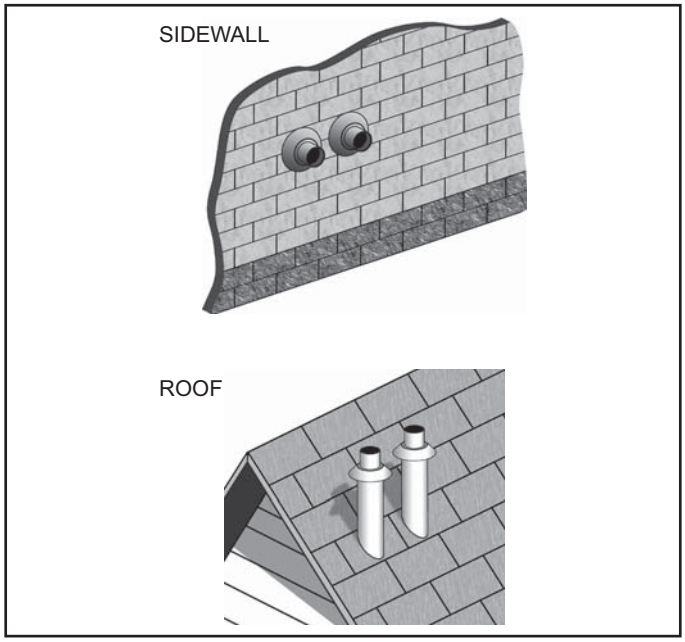


Figure 37

Four Concentric Terminations

Four concentric terminations may be installed in close proximity as shown in Figure 38. See Figure 34 and Figure 35 on page 32 for detailed information on clearances and additional arrangement options.

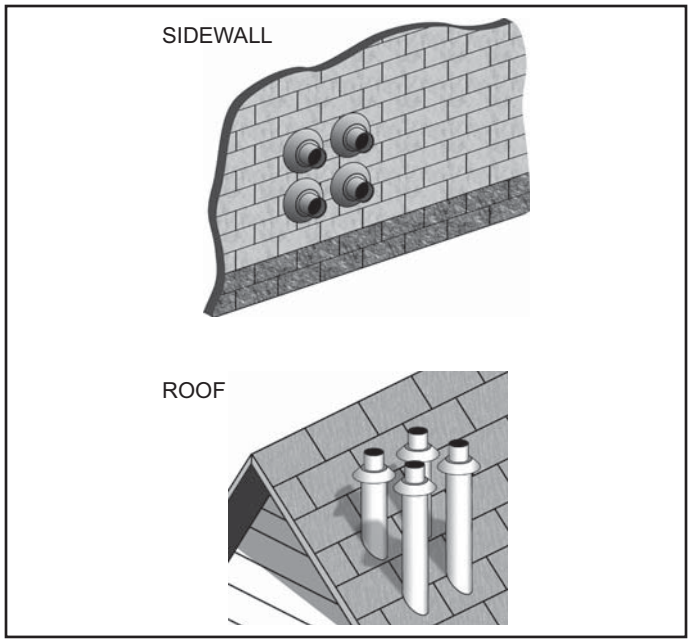


Figure 38

Eight Concentric Terminations

Eight concentric terminations may be installed in two stacked groups of four, in close proximity, as shown in Figure 39. See Figure 36 on page 32 for detailed information on clearances.

Lateral groups of four as shown in Figure 35 on page 32 may be a more convenient installation arrangement for multiple groups depending on available space.

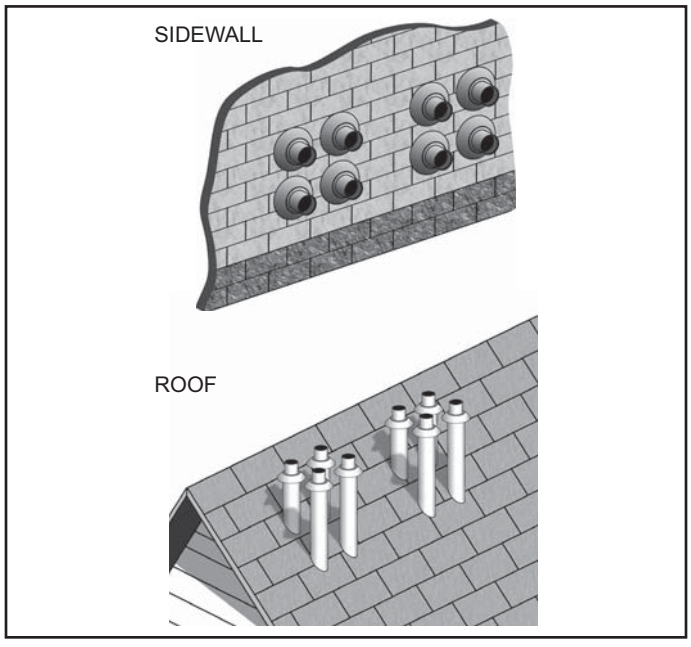
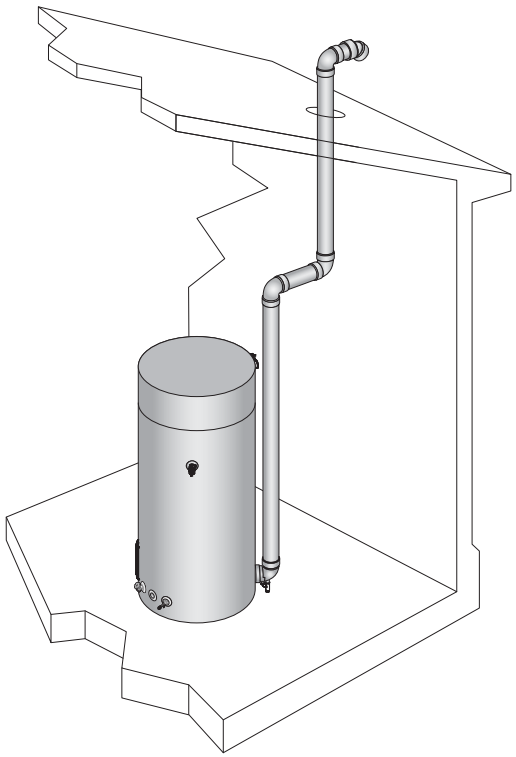
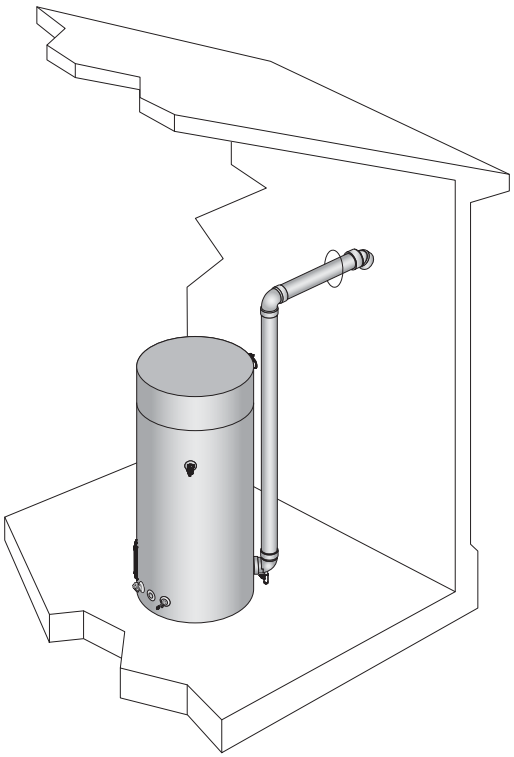


Figure 39

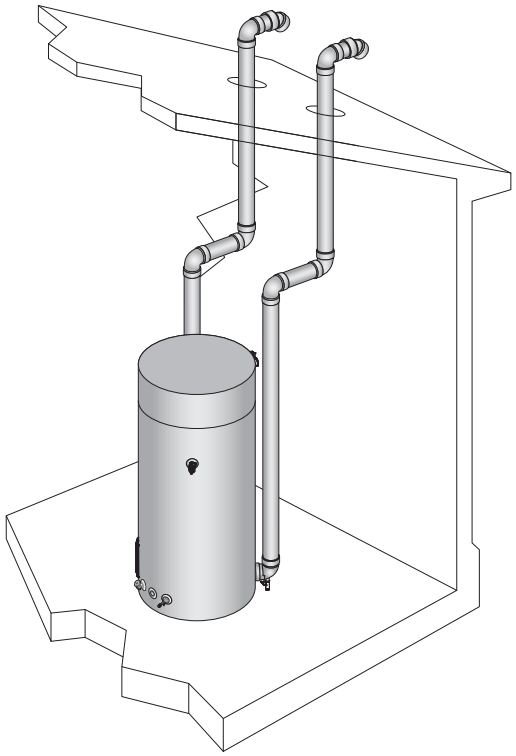
VENTING ARRANGEMENTS



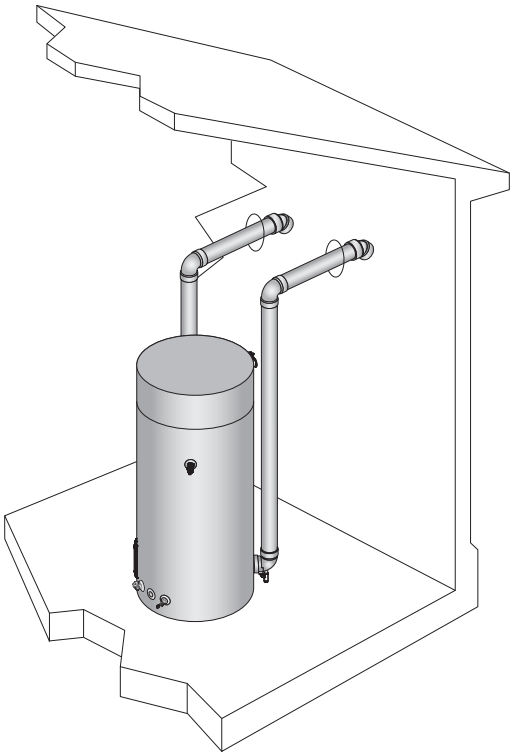
Power Vent Vertical
Figure 40



Power Vent Horizontal
Figure 41

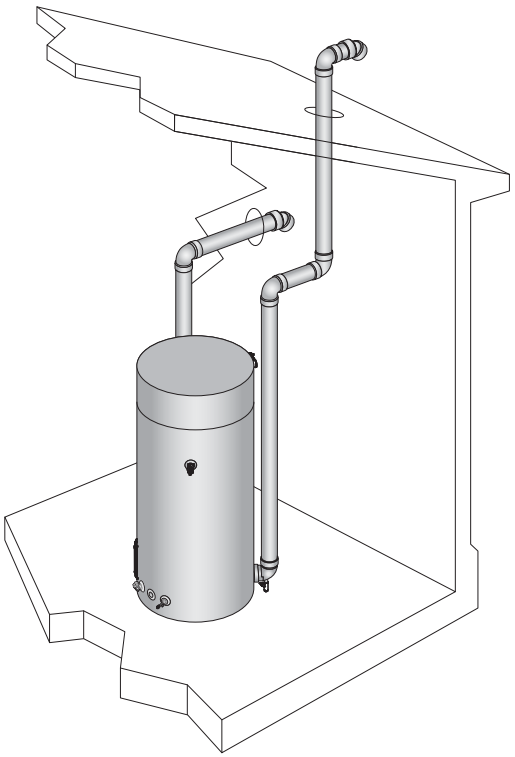


Direct Vent Vertical
Figure 42

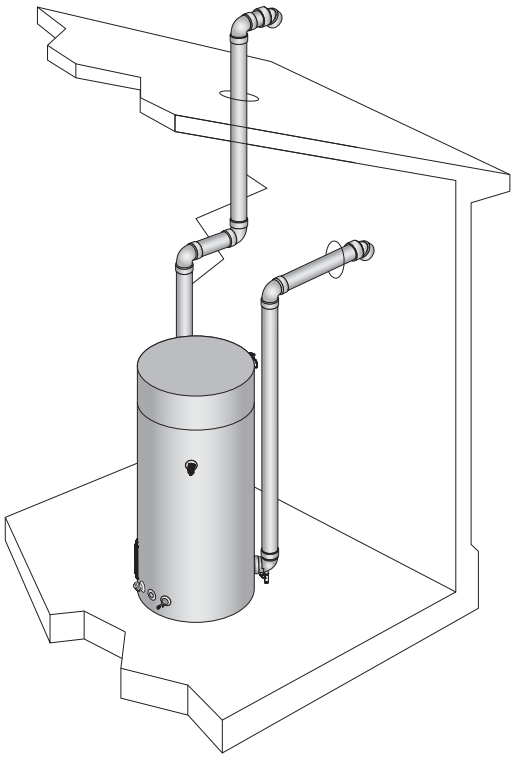


Direct Vent Horizontal
Figure 43

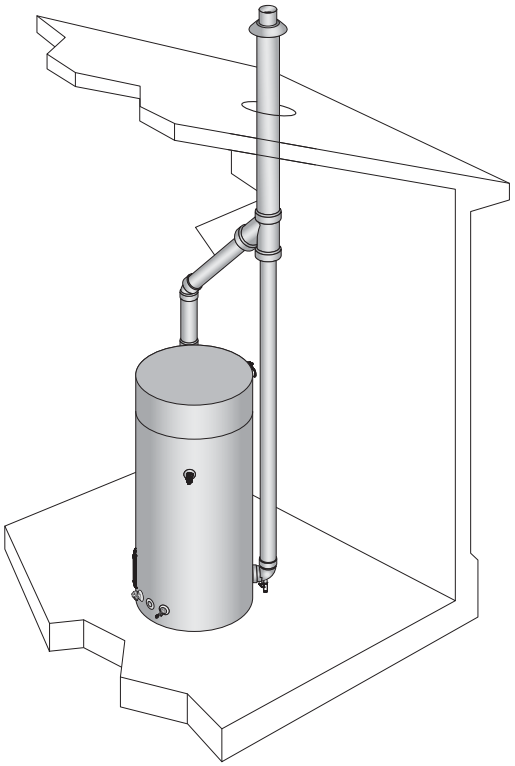
VENTING ARRANGEMENTS



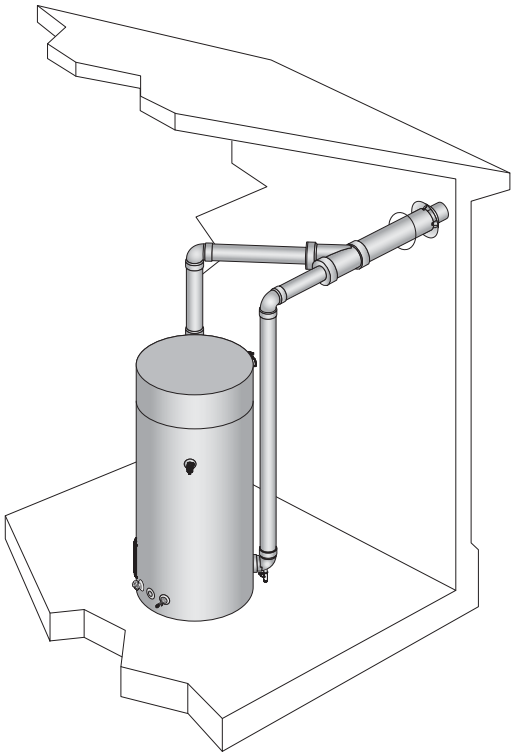
Direct Vent Vertical Vent Horizontal Intake
Figure 44



Direct Vent Horizontal Vent Vertical Intake
Figure 45



Direct Vent Vertical Concentric
Figure 46



Direct Vent Horizontal Concentric
Figure 47

TERMINATION CLEARANCES SIDEWALL POWER VENT

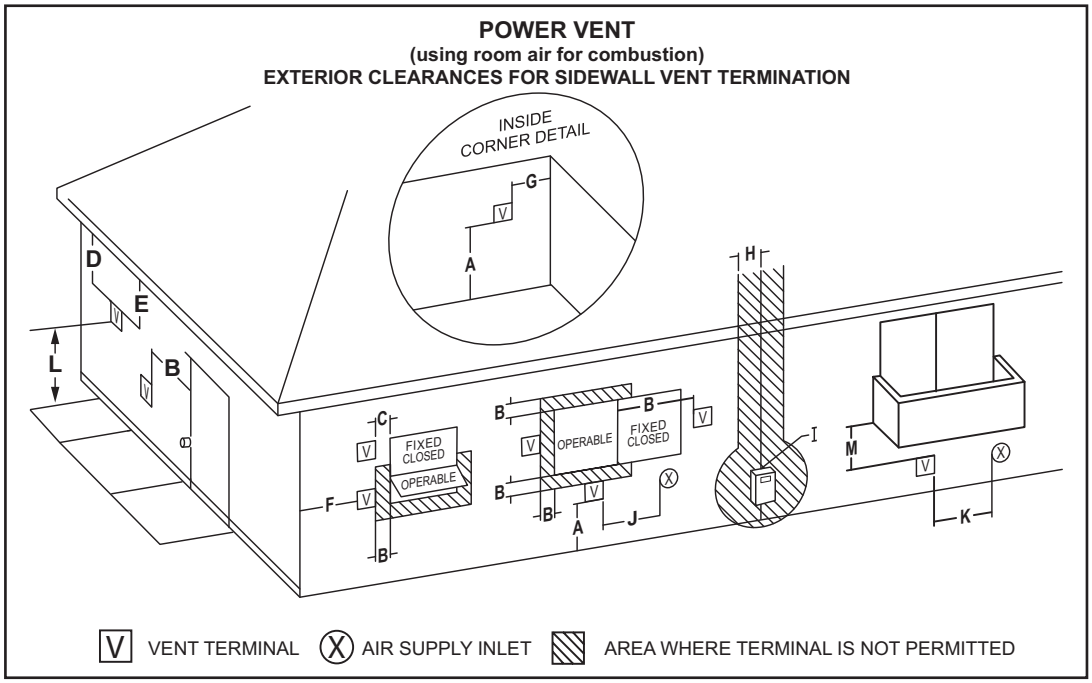


Figure 48

Vent terminal clearances for "Power Vent" installations. Power Vent configurations use room air for combustion.

		CANADIAN INSTALLATIONS [1]	US INSTALLATIONS [2]			CANADIAN INSTALLATIONS [1]	US INSTALLATIONS [2]
A	Clearance above grade, veranda, porch, deck or balcony	12 inches (30 cm)	12 inches (30 cm)	**H**	Clearance to each side of center line extended above meter/regulator assembly	3 feet (91 cm) within a height 15 feet (4.5 m) above the meter/ regulator assembly	3 feet (91 cm) within a height 15 feet (4.5 m) above the meter/regulator assembly*
B	Clearance to window or door that may be opened	6 inches (15 cm) for appliances up to 10,000 Btu/hr (3 kW), 12 inches (30 cm) for appliances between 10,000 Btu/hr (3 kW) and 100,000 Btu/hr (30 kW), 36 inches (91 cm) for appliances above 100,000 Btu/hr (30 kW)	4 feet (1.2 m) below or to side of opening; 1 foot (30 cm) above opening	**I**	Clearance to service regulator vent outlet	3 feet (91 cm)	3 feet (91 cm)*
C	Clearance to permanently closed window	12 inches (30 cm)*	12 inches (30 cm)*	**J**	Clearance to a non mechanical air supply inlet into building or combustion air inlet to any other appliance	6 inches (15 cm) for appliances up to 10,000 Btu/hr (3 kW), 12 inches (30 cm) for appliances between 10,000 Btu/hr (3 kW) and 100,000 Btu/hr (30kW), 36 inches (91cm) for appliances above 100,000 Btu/ hr (30 kW)	4 feet (1.2 m) below or to side of opening; 1 foot (30 cm) above opening.
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal	12 inches (30 cm)*	12 inches (30 cm)*	**K**	Clearance to a mechanical air supply inlet	6 feet (1.83 m)	3 feet (91 cm) above if within 10 feet (3 m) horizontally
E	Clearance to unventilated soffit	12 inches (30 cm)*	12 inches (30 cm)*	**L**	Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.13 m)†	7 feet (2.13 m)
F	Clearance to outside corner	2 feet (60 cm)*	2 feet (60 cm)*	**M**	Clearance under veranda, porch, deck, or balcony	12 inches (30 cm) ‡	12 inches (30 cm) ‡
G	Clearance to inside corner	18 inches (45 cm)*	18 inches (45 cm)*				

1 In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code.

2 In accordance with the current ANSI Z223.1/NFPA 54, National Fuel Gas Code.

† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.

* Clearance in accordance with local installation codes and the requirements of the gas supplier and the manufacturer's installation instructions.

TERMINATION CLEARANCES SIDEWALL DIRECT VENT

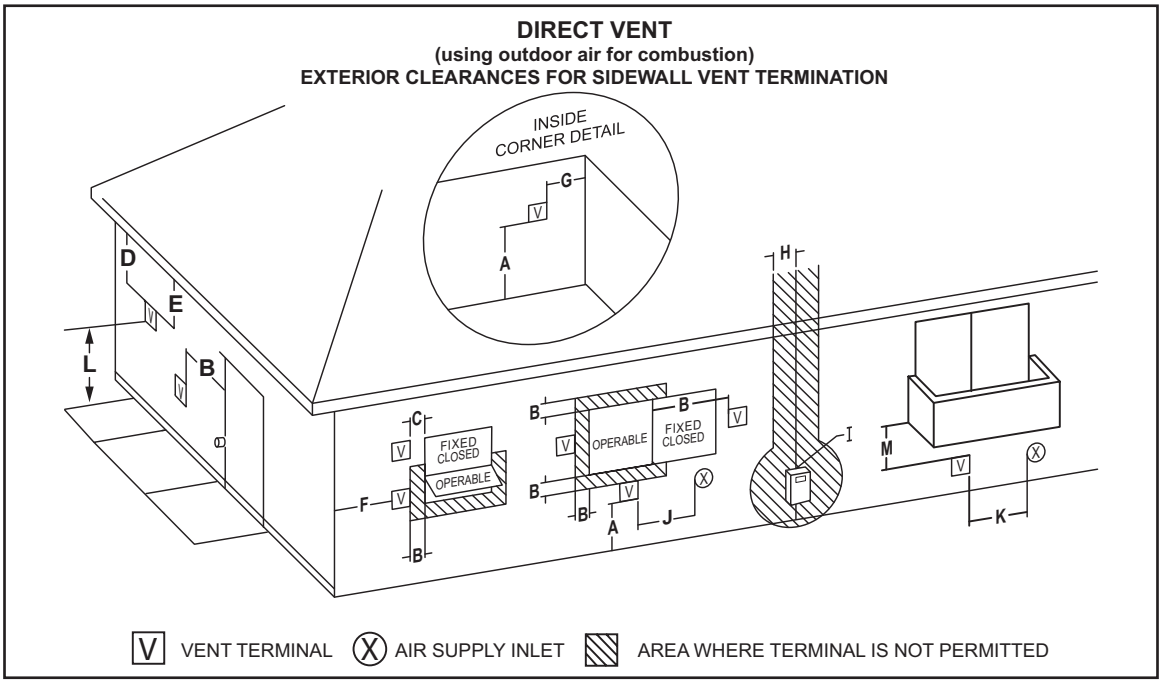


Figure 49

Vent terminal clearances for "Direct Vent" installations. Direct Vent configurations use outdoor air for combustion.

		CANADIAN INSTALLATIONS [1]	US INSTALLATIONS [2]			CANADIAN INSTALLATIONS [1]	US INSTALLATIONS [2]
A	Clearance above grade, veranda, porch, deck or balcony	12 inches (30 cm)	12 inches (30 cm)	**H**	Clearance to each side of center line extended above meter/regulator assembly	3 feet (91 cm) within a height 15 feet (4.5 m) above the meter/ regulator assembly	3 feet (91 cm) within a height 15 feet (4.5 m) above the meter/regulator assembly*
B	Clearance to window or door that may be opened	6 inches (15 cm) for appliances up to 10,000 Btu/hr (3 kW), 12 inches (30 cm) for appliances between 10,000 Btu/hr (3 kW) and 100,000 Btu/hr (30 kW), 36 inches (91 cm) for appliances above 100,000 Btu/hr (30 kW)	6 inches (15 cm) for appliances up to 10,000 Btu/hr (3 kW), 9 inches (23 cm) for appliances between 10,000 Btu/hr (3 kW) and 50,000 Btu/hr (15 kW), 12 inches (30 cm) for appliances above 50,000 Btu/hr (15 kW)	**I**	Clearance to service regulator vent outlet	3 feet (91 cm)	3 feet (91 cm)*
C	Clearance to permanently closed window	6 inches (15 cm)*	6 inches (15 cm)*	**J**	Clearance to a non mechanical air supply inlet into building or combustion air inlet to any other appliance	6 inches (15 cm) for appliances up to 10,000 Btu/hr (3 kW), 12 inches (30 cm) for appliances between 10,000 Btu/hr (3 kW) and 100,000 Btu/hr (30 kW), 36 inches (91 cm) for appliances above 100,000 Btu/ hr (30 kW)	6 inches (15 cm) for appliances up to 10,000 Btu/hr (3 kW), 9 inches (23 cm) for appliances between 10,000 Btu/hr (3 kW) and 50,000 Btu/hr (15 kW), 12 inches (30 cm) for appliances above 50,000 Btu/hr (15 kW)
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal	12 inches (30 cm)*	12 inches (30 cm)*	**K**	Clearance to a mechanical air supply inlet	6 feet (1.83 m)	3 feet (91 cm) above if within 10 feet (3 m) horizontally
E	Clearance to unventilated soffit	12 inches (30 cm)*	12 inches (30 cm)*	**L**	Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.13 m)†	7 feet (2.13 m)†*
F	Clearance to outside corner	2 feet (60 cm)*	2 feet (60 cm)*	**M**	Clearance under veranda, porch, deck, or balcony	12 inches (30 cm) ‡	12 inches (30 cm) ‡*
G	Clearance to inside corner	18 inches (45 cm)*	18 inches (45 cm)*				

1 In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code.

2 In accordance with the current ANSI Z223.1/NFPA 54, National Fuel Gas Code.

† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.

* Clearance in accordance with local installation codes and the requirements of the gas supplier and the manufacturer's installation instructions.

WATER HEATER INSTALLATION

CONDENSATE DRAIN INSTALLATION

Installation must conform with these instructions and local building codes.

Field supplied materials required for installation include:

- Approved PVC cement and PVC primer.
- 1/2 inch PVC pipe - minimum length to equal the distance between the water heater and a suitable building drain.
- 1/2 inch PVC fittings (elbows and couplings) necessary to install a condensate drain line between the Condensate Drain Trap Assembly and a suitable building drain.
- Floor mounted standoffs to brace the drain line.

INSTALLATION NOTES

1. The condensate drains from the water heater's covered by this instruction have PH levels between 4.3 and 5.0. Install a commercially available neutralizing kit if required by local codes. Lower PH levels are acidic. Do not connect a metal condensate drain line, such as copper pipe, to the water heater for this reason.
2. The field installed condensate drain line must not be less than 1/2 inch PVC in size.
3. **DO NOT** remove, modify or alter the factory condensate trap.

INSTALLATION INSTRUCTIONS

1. Ensure the water heater's on/off switch is in the "off" position.
2. Install a 1/2 inch PVC condensate drain line between the condensate drain connection on the Condensate Drain Trap and a suitable building drain, see Figure 50 and Figure 51.
3. Terminate the condensate drain piping with an elbow above the drain. Ensure that any discharge will exit the condensate drain line no more than 6 inches (15.2 cm) above a suitable building drain, or external to the building, see Figure 50.

   NOTE: In cold climates it is recommended the condensate drain be terminated at a suitable drain inside the building.
4. Ensure the condensate drain line is not elevated above the condensate drain connection on the trap, see Figure 51.
5. Brace the condensate drain line with floor mounted standoffs every three feet.
6. Ensure the condensate drains freely during start up, see Start Up on page 52.

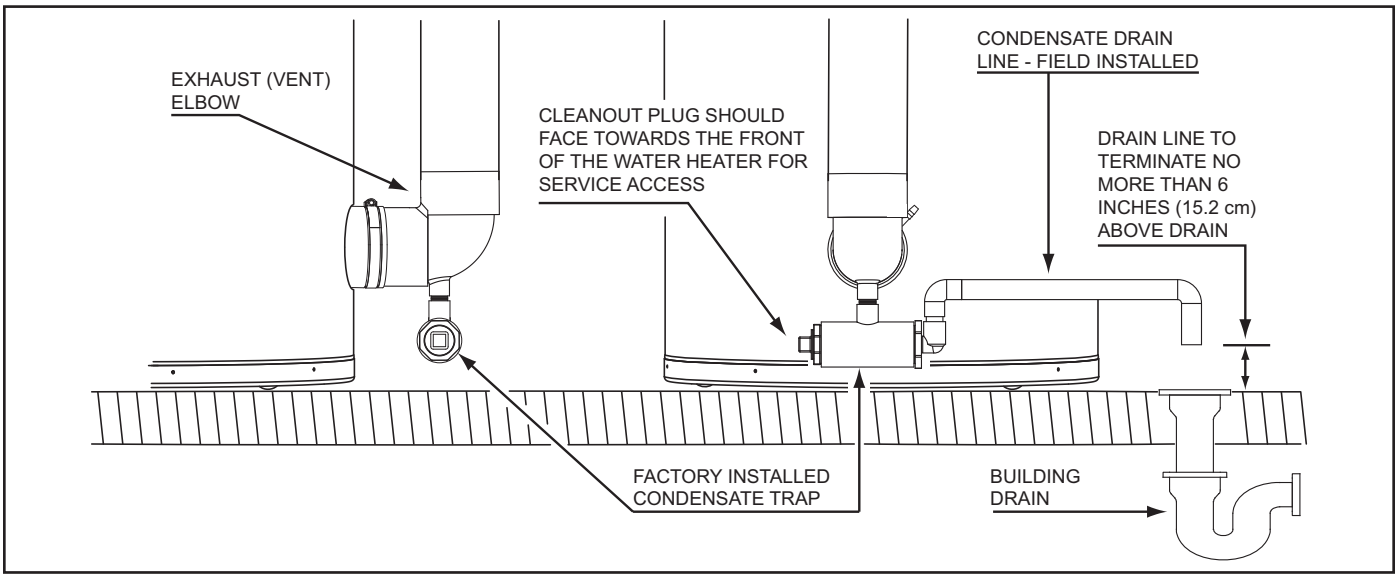


Figure 50

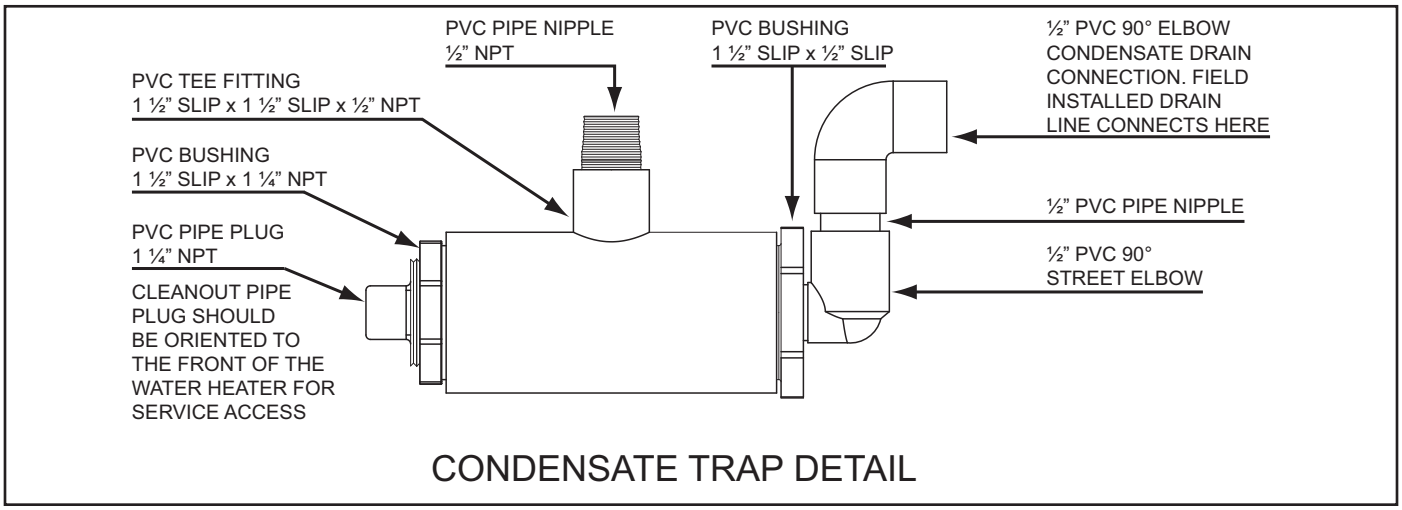


Figure 51

SUPPLY GAS LINE INSTALLATION

Contact your local gas utility company to ensure that adequate gas service is available and to review applicable installation codes for your area.

Be sure that the gas meter has sufficient capacity to supply the rated gas input of the water heater as well as the requirements of all other gas fired equipment supplied by the meter. If the gas meter is undersized, the gas company will have to install a properly sized gas meter.

⚠ WARNING

Fire and Explosion Hazard

- Do not use water heater with any gas other than the gas shown on the rating label.
- Excessive gas pressure to gas valve can cause serious injury or death.
- Turn off gas lines during installation.
- Contact a qualified installer or service agency for installation and service.

Make sure gas supplied is same type listed on the water heater's rating label.

The water heaters covered in this manual are not intended for operation at higher than 10.5" W. C. (2.62 kPa) for natural gas and 14.0" W. C. (3.49 kPa) for propane gas supply pressure, see Table 4 on page 14. The water heaters covered in this manual require supply gas regulators to maintain required supply gas pressure. Exposure to higher gas supply pressure may cause damage to the gas controls which could result in fire or explosion. If overpressure has occurred such as through improper testing of gas lines or malfunction of the supply system the water heater's gas valve must be checked for safe operation by a Qualified Service Agency.

Ensure supply regulator vent lines and the safety vent valves are protected against blockage. These are components of the gas supply system, not the water heater. Vent blockage may occur during ice storms.

It is important to guard against gas valve fouling from contaminants in the gas ways. Such fouling may cause improper operation, fire or explosion. If copper supply lines are used they must be internally tinned and certified for gas service.

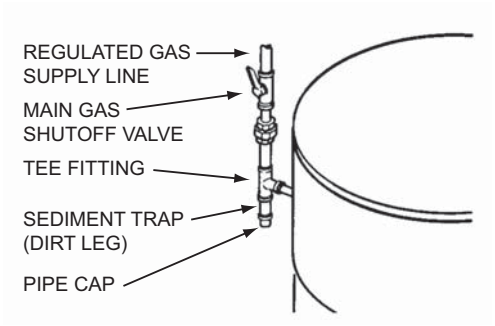


Figure 52

Ensure all gas pipe is clean on the inside before installation. To trap any dirt or foreign material in the gas supply line a sediment trap (dirt leg) must be installed as shown in Figure 52. The sediment trap must be readily accessible and not subject to freezing conditions. Install in accordance with the recommendations of the local gas utility company.

GAS LINE SIZING

DO NOT use flexible gas piping.

Minimum required supply gas line sizes are shown in Table 5 on page 14. Depending on the developed equivalent length and/or the number of appliances connected to a common main, the size of supply gas lines may have to be increased.

Size the supply/main gas line(s) in accordance with Table 8 or Table 9. The values given in Table 8 and Table 9 are for straight lengths of iron pipe at 0.5" W. C. (125 Pa) pressure drop, which is considered normal for low pressure systems. Note that fittings such as elbows and tees will add to the pipe pressure drop.

SUPPLY GAS LINE SIZING U. S. UNITS

TABLE 8

LENGTH IN FEET	NORMAL IRON PIPE SIZES (INCHES) INPUT IN THOUSANDS BTU/HR					
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
10	175	360	680	1400	2100	3960
20	120	250	485	950	1460	2750
30	97	200	375	770	1180	2200
40	82	170	320	660	990	1900
50	73	151	285	580	900	1680
60	66	138	260	530	810	1520
70	61	125	240	490	750	1400
80	57	118	220	460	690	1300
90	53	110	205	430	650	1220
100	50	103	195	400	620	1150
125	44	93	175	360	550	1020
150	40	84	160	325	500	950
175	37	77	145	300	460	850
200	35	72	135	280	430	800

SUPPLY GAS LINE SIZING METRIC UNITS

TABLE 9

LENGTH IN METERS	NORMAL IRON PIPE SIZES (INCHES) INPUT IN kW					
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
3.0	51	105	199	410	615	1160
6.1	35	73	142	278	428	805
9.1	28	59	110	225	346	644
12.2	24	50	94	193	290	556
15.2	21	44	83	170	264	492
18.3	19	40	76	155	237	445
21.3	18	37	70	143	220	410
24.4	17	35	64	135	202	381
27.4	16	32	60	126	190	357
30.5	15	30	57	117	182	337
38.1	13	27	51	105	161	299
45.7	12	25	47	95	146	278
53.3	11	23	42	88	135	249
61.0	10	21	40	82	126	234

GAS LINE CONNECTION

1. The water heaters covered by this manual are shipped from the factory with 3/4 inch supply gas connections. The supply gas line must not be smaller than 3/4 inch, see Table 5 on page 14. Connect the supply gas line to the water heater's 24 Volt Gas Valve in accordance with all applicable local and national code requirements. **DO NOT** use flexible gas piping.
2. Depending on the developed equivalent length and/or the number of appliances connected to a common main, the size of the supply gas line may have to be increased, see Gas Line Sizing on page 39. If the supply gas line must be re-sized larger to accommodate increased supply gas line lengths or multiple appliances use reducer couplings and short pipe nipples to increase the supply gas line as shown in Figure 53.

   NOTE: Make the transition to the larger supply gas line as close to the supply gas connection as possible.

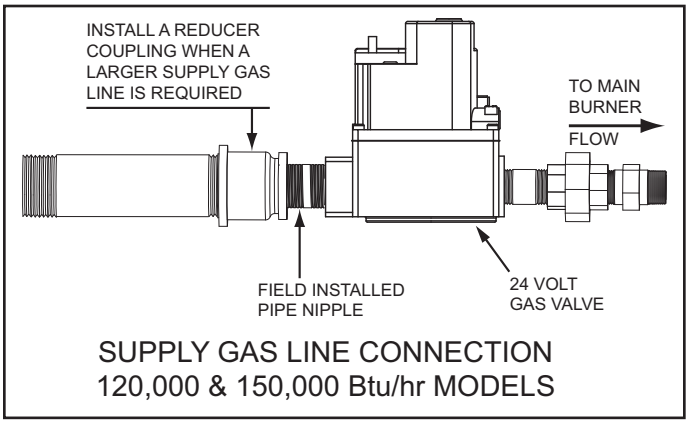

INSTALL A REDUCER COUPLING WHEN A LARGER SUPPLY GAS LINE IS REQUIRED
TO MAIN BURNER
FLOW
FIELD INSTALLED PIPE NIPPLE
24 VOLT GAS VALVE
SUPPLY GAS LINE CONNECTION
120,000 & 150,000 Btu/hr MODELS

Figure 53

3. Apply thread sealing compounds (pipe dope/Teflon tape) sparingly and only to the male threads of the pipe joints. Do not apply sealing compound to the first two threads. Use pipe dope or Teflon tape marked as being resistant to the action of liquid petroleum (LP/propane) gases.

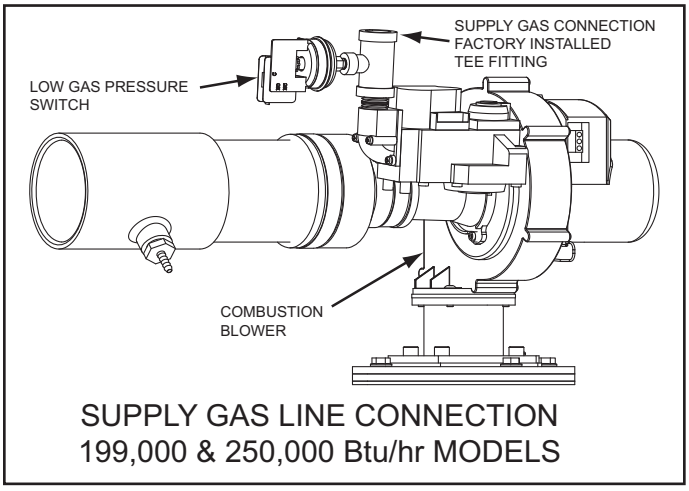
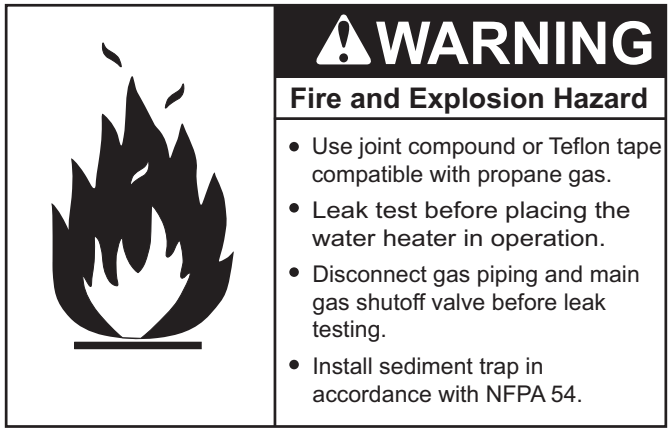

SUPPLY GAS CONNECTION FACTORY INSTALLED TEE FITTING
LOW GAS PRESSURE SWITCH
COMBUSTION BLOWER
SUPPLY GAS LINE CONNECTION
199,000 & 250,000 Btu/hr MODELS

Figure 54

4. Use only a smooth jaw adjustable wrench (such as a monkey wrench) as a back up on the body of the 24 Volt Gas Valve when tightening the first pipe nipple into the body of the valve. **DO NOT** use a standard pipe wrench (Stillson wrench) with metal tooth jaws as this may permanently damage the valve.
5. Use a standard pipe wrench (Stillson wrench) as a back up on the first pipe nipple installed above when connecting other fittings and pipe in the supply gas line to prevent the 24 Volt Gas Valve on the water heater from twisting during installation.
6. To prevent damage, care must be taken not to apply too much torque when connecting the supply gas line to the water heater.
7. Install a sediment trap (dirt leg) as shown in Figure 52 on page 39.
8. Install a Main Gas Shutoff valve in the supply gas line as shown in Figure 52 on page 39.

NOTE: Should overheating occur or the gas supply fail to shut off, turn off the Main Gas Shutoff valve to the water heater.

GAS LINE LEAK TESTING


WARNING
Fire and Explosion Hazard
• Use joint compound or Teflon tape compatible with propane gas.
• Leak test before placing the water heater in operation.
• Disconnect gas piping and main gas shutoff valve before leak testing.
• Install sediment trap in accordance with NFPA 54.

Any time work is done on the gas supply system perform a leak test to avoid the possibility of fire or explosion.

1. For test pressures exceeding 1/2 psi (3.45 kPa) disconnect the water heater and its Main Gas Shutoff Valve from the gas supply piping system during testing, see Figure 52 on page 39. The gas supply line must be capped when disconnected from the water heater.
2. For test pressures of 1/2 psi (3.45 kpa) or less, the appliance need not be disconnected, but must be isolated from the supply gas line by closing the Main Gas Shutoff Valve during testing.
3. Paint all supply gas line joints and connections upstream of the water heater with a rich soap and water solution to test for leaks. Bubbles indicate a gas leak. Do not use matches, candles, flame or other sources of ignition for this purpose.
4. Repair any leaks before placing the water heater in operation.

ELECTRICAL WIRING

All electrical work must be installed in accordance with the National Electrical Code, ANSI/NFPA 70 or the Canadian Electrical Code, CSA C22.1 and local requirements.

When installed, the water heater must be electrically grounded in accordance with local codes or, in the absence of local codes, with the National Electrical Code, ANSI/NFPA 70 or the Canadian Electrical Code, CSA C22.1.

If any of the original wire as supplied with the water heater must be replaced, it must be replaced with 105°C rated wiring or its equivalent, except in the burner housing. In this case use 200°C rated wire must be used.

POWER SUPPLY CONNECTIONS

Read the requirements for the Power Supply on page 14 before connecting power.

Correct Polarity:

The water heater's control system is polarity sensitive and will lock out and disable heating operation if the polarity of the power supply is reversed. The control system will display the "AC Reversed" Fault message on the LCD. The 120 VAC hot wire from the power supply must connect to the black wire in the junction box and the 120 VAC neutral wire must connect to the white wire in the junction box for correct polarity.

Power supply connections must be made as follows:

1. Ensure the power supply is turned off at the breaker or disconnect switch.
2. Remove the junction box cover. See beginning on page 8 for junction box location.
3. Connect the 120 VAC hot wire from the power supply to the black wire in the junction box on top of the water heater with a properly sized wire nut. Wrap electrical tape around the wire nut and wire end. See wiring diagrams Figure 66 on page 68 and Figure 67 on page 69.
4. Connect the 120 VAC neutral wire from the power supply to the white wire in the junction box. Wrap electrical tape around the wire nut and wire end. See wiring diagrams Figure 66 on page 68 and Figure 67 on page 69.
5. Connect the ground wire from the power supply to the grounding lug inside the junction box. See wiring diagrams Figure 66 on page 68 and Figure 67 on page 69.
6. Replace the junction box cover when connections are complete.

NOTE: Do not apply power to the water heater before installation is complete and the water heater is filled with water.

ENABLE/DISABLE CIRCUIT

The water heaters covered in this manual are equipped with an enable/disable circuit for use with field supplied external supervisory controls such as time clocks or building Building Management Systems. The enable/disable circuit may be used to disable heating operation during periods when the building is unoccupied or there is no demand for hot water.

To use the enable/disable circuit it must first be activated by configuring the S1 dipswitch on the water heater's CCB (central control board), see Figure 65 on page 67. Field supplied wiring is then installed between the water heater's CCB and a set of "dry contacts" (no voltage or load) on the field supplied external control.

NOTE: The water heater's enable/disable circuit is a switching circuit only: Do not apply external voltage or connect any load (IE: relay coil) to this circuit. This will damage the CCB circuit board and is not covered under the limited warranty.

Connecting An External Supervisory Control

The enable/disable circuit is accessed from the CCB's J6 plug inside the CCB enclosure, see beginning on page 8 to locate the CCB enclosure. From the factory there is a short (black) jumper wire installed between pins 8 and 11 of the J6 plug, see Figure 65 on page 67 to locate the J6 plug.

Install field wiring to the enable/disable circuit:

1. Turn off power at the water heater's on/off switch and the breaker that supplies power to the appliance.
2. Locate the CCB enclosure.
3. Remove the screws from the CCB enclosure cover and carefully open the CCB enclosure. Note how strain relief for the wiring is provided between the cover and enclosure along one edge.
4. Activate the enable/disable circuit; locate the S1 dipswitch on the CCB, see Figure 65 on page 67.
   - Toggle S1 dipswitch #2 to the open position.
   - Toggle S1 dipswitch #3 to the open position.
5. Locate the black jumper wire between pin 8 and 11 on the CCB J6 plug, see Figure 65 on page 67 and Figure 66 on page 68.
6. Cut the black jumper wire in the middle.
7. Strip approximately 1/2 inch of insulation from the two ends of the black jumper wire.
8. Using wire nuts connect two field supplied control wires to the two ends of the black jumper wire. Wrap electrical tape around the wire nut connections.
9. Thread the control wires out of the CCB enclosure with the other wiring and carefully replace the CCB enclosure cover. Ensure all wiring is routed through the indented area provided for strain relief. Ensure no wiring is being pinched.
10. Reinstall the CCB enclosure cover screws and tighten.
11. Route the control wires inside the junction box on the top of the water heater, see beginning on page 8 to locate the junction box. Use an available knock-out to route the wires inside the junction box.
12. Install field supplied control wiring and conduit as required by national and local codes between the water heater's junction box and the external supervisory control. Connect the wiring from the external control to the control wires inside the junction box using wire nuts and electrical tape.
13. Connect the control wiring to a set of dry contacts on the external control. Follow the control manufacturers instructions for making connections.
14. Restore power to the water heater.

NOTE: Whenever the external control opens the set of dry contacts used, heating operation will be disabled. Whenever the external control closes the set of dry contacts used, heating operation will be enabled. A diagonal line and circle appears over the thermometer icon on the control system's display when heating operation is disabled. See the Status Icons descriptions in Table 11 on page 45.

NOTE: Ensure the water heater is protected from freezing temperatures when heating operation is disabled. Damage to the water heater caused by freezing temperatures is not covered under the limited warranty.

WATER LINE CONNECTIONS

The water piping installation must conform to these instructions and to all local and national code authority having jurisdiction. Good practice requires that all heavy piping be supported.

Read and observe all requirements in the following sections before installation of the water piping begins:

1. Mixing Valves on page 15.
2. Dishwashing Machines on page 15.
3. Temperature-Pressure Relief Valve on page 16.
4. Closed Systems and Thermal Expansion on page 15.
5. For multiple water heater installations see Water Piping Diagrams beginning on page 71.

WATER PIPING DIAGRAMS

This manual provides detailed water piping diagrams for typical methods of application for the water heaters, see Water Piping Diagrams beginning 71.

The water heater may be installed by itself, or with a separate storage tank. When used with a separate storage tank, the circulation may be either by gravity or by means of circulating pump. When a circulating pump is used, it is important to note that the flow rate should be slow so that there will be a minimum of turbulence inside the water heater storage tank.

Adjust flow by throttling a full port ball valve installed in the circulating line on the outlet side of the pump. Never throttle flow on the suction side of a pump. See the Water Piping Diagrams beginning on page 71.

NOTE: In addition to the factory installed Temperature-Pressure Relief Valve (T&P valve) on the water heater, each remote storage tank that may be installed and piped to a water heating appliance must also have its own properly sized, rated and approved Temperature-Pressure Relief Valve installed.

Call the toll free technical support phone number listed on the back cover of this manual for further assistance in sizing a T&P valve for remote storage tanks.

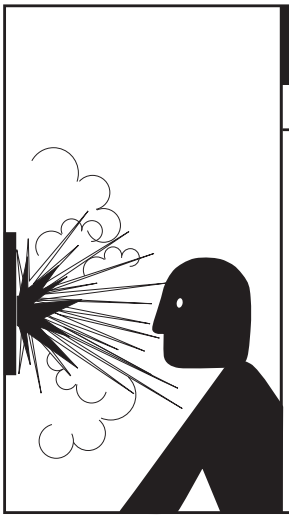
THERMOMETERS (NOT SUPPLIED)

Thermometers are installed in the water piping system as a means of detecting the temperature of the hot water supply at critical points in the system. Field supplied thermometers should be obtained and installed. See Water Piping Diagrams on page 71.

WATER (POTABLE) HEATING AND SPACE HEATING

1. All water piping components connected to the water heater that are for space heating applications shall be suitable for use with potable water.
2. Toxic chemicals, such as those used for boiler treatment, must NEVER be introduced into this system.
3. The water heaters covered in this manual may never be connected to any existing heating system or component(s) previously used with non-potable water heating appliance.
4. When the system requires water for space heating that exceed safe temperatures at domestic water fixtures a mixing valve must be installed, see Mixing Valves on page 15.
5. These water heaters cannot be used in space heating applications only.

T&P VALVE DISCHARGE PIPE



⚠WARNING

Explosion Hazard

- Temperature-Pressure Relief Valve must comply with ANSI Z21.22-CSA 4.4 and ASME code.
- Properly sized temperature-pressure relief valve must be installed in opening provided.
- Can result in overheating and excessive tank pressure.
- Can cause serious injury or death.

This water heater is provided with a properly rated/sized and certified combination temperature - pressure (T&P) relief valve by the manufacturer. See Temperature-Pressure Relief Valve on page 16 for information on replacement and other requirements.

CAUTION

Water Damage Hazard

- Temperature-Pressure Relief Valve discharge pipe must terminate at adequate drain.

Install a discharge pipe between the T&P valve discharge opening and a suitable floor drain. Do not connect discharge piping directly to the drain unless a 6” (15.2 cm) air gap is provided. To prevent bodily injury, hazard to life, or property damage, the relief valve must be allowed to discharge water in adequate quantities should circumstances demand. If the discharge pipe is not connected to a drain or other suitable means, the water flow may cause property damage.

T&P Valve Discharge Pipe Requirements:

- Shall not be smaller in size than the outlet pipe size of the valve, or have any reducing couplings or other restrictions.
- Shall not be plugged or blocked.
- Shall not be exposed to freezing temperatures.
- Shall be of material listed for hot water distribution.
- Shall be installed so as to allow complete drainage of both the Temperature-Pressure Relief Valve and the discharge pipe.
- Must terminate a maximum of six inches above a floor drain or external to the building. In cold climates, it is recommended that the discharge pipe be terminated at an adequate drain inside the building.
- Shall not have any valve or other obstruction between the relief valve and the drain.

TEMPERATURE REGULATION

HIGH TEMPERATURE LIMIT CONTROL (ECO)

This water heater is equipped with an ECO (energy cut off) non adjustable high temperature limit switch. The ECO is a normally closed switch that opens (activates) on a rise in temperature.

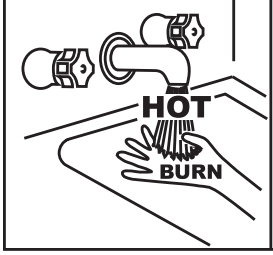
The ECO is located inside the Upper Temperature Probe (two red wires), see pages 8 and 9 for location. The ECO switch contacts will open when the water temperature reaches approximately 202°F (94°C) and close at approximately 140°F (49°C).

If the ECO activates (contacts open) due to abnormally high water temperatures in the storage tank the control system will immediately de-energize the 24 Volt Gas Valve and end the current heating cycle. The control system will "lock out" disabling further heating operation. The control system will display the "Energy Cut Out (ECO)" Fault message on the LCD screen. It is important that a Qualified Service Agent be contacted to determine the reason for the ECO activation before resetting the ECO. Once the reason has been determined and corrected the ECO can be reset as follows:

Should the ECO activate, the water temperature must drop below 140°F (49°C) before the control system can be reset. Once the water temperature has cooled below this point the power supply to the water heater must be turned off and on again to reset the control system.

THERMOSTAT CONTROL

⚠DANGER



Water temperature over 125°F (52°C) can cause severe burns instantly resulting in severe injury or death.

Children, the elderly and the physically or mentally disabled are at highest risk for scald injury.

Feel water before bathing or showering.

Temperature limiting devices such as mixing valves must be installed when required by codes and to ensure safe temperatures at fixtures.

Hot water temperatures required for automatic dishwasher and laundry use can cause scald burns resulting in serious personal injury and/or death. Table 10 shows the approximate time-to-burn relationship for normal adult skin.

The temperature at which injury occurs varies with the person's age and duration of exposure. The slower response time of children, the elderly or disabled persons increases the hazards to them. If anyone using hot water provided by the water heater being installed fits into one of these groups or if there is a local code or state law requiring a certain water temperature at the point of use, then special precautions must be taken.

In addition to using the lowest possible temperature setting that satisfies the demand of the application a mixing valve can be installed at the water heater (see Figure 8 on page 15) or at the hot water taps to further reduce system water temperature.

Never allow small children to use a hot water tap or draw their own bath water. Never leave a child or disabled person unattended in a bathtub or shower.

The water heater should be located in an area where the general public does not have access to set temperatures.

Setting the Operating Set Point at 120°F (49°C) will reduce the risk of scalds. Some States require settings at specific lower temperatures.

TABLE 10

Water Temperature	Time to Produce 2nd & 3rd Degree Burns on Adult Skin
180°F (82°C)	Nearly instantaneous
170°F (77°C)	Nearly instantaneous
160°F (71°C)	About 1/2 second
150°F (66°C)	About 1-1/2 seconds
140°F (60°C)	Less than 5 seconds
130°F (54°C)	About 30 seconds
120°F (49°C)	More than 5 minutes

The water heaters covered in this manual are equipped with an electronic control system to regulate the water temperature inside the storage tank. The control system senses temperature from two factory installed temperature probes, one installed in the top of the storage tank and one installed near the bottom, See Top Views on page 8 and Figure 5 on page 10 for location.

The "Operating Set Point" is adjusted to regulate water temperature inside the storage tank. This is an adjustable user setting in the control system's "Temperatures Menu." This and all control system menus are accessed through the UIM (user interface module) located on the front of the water heater, see Figure 55.

The Operating Set Point is adjustable from 90°F (42°C) to 180°F (82°C). The factory setting is 120°F (49°C). See Operating Set Point And Differential Adjustment on page 47 for instructions on how to adjust the Operating Set Point and other user settings.

Set the Operating Set Point at the lowest setting which produces an acceptable hot water supply. This will always provide the most energy efficient operation.

HIGH TEMPERATURE APPLICATIONS

Higher operating temperatures cause more wear on all water heaters and will decrease the life span of the appliance. Consider installing a small booster water heater for high temperature applications, such as commercial dishwashers, to raise the outlet temperature from the larger primary water heater to the desired point of use temperature.

Contact your local distributor or call the technical support phone number listed on the back cover of this manual for further technical assistance.

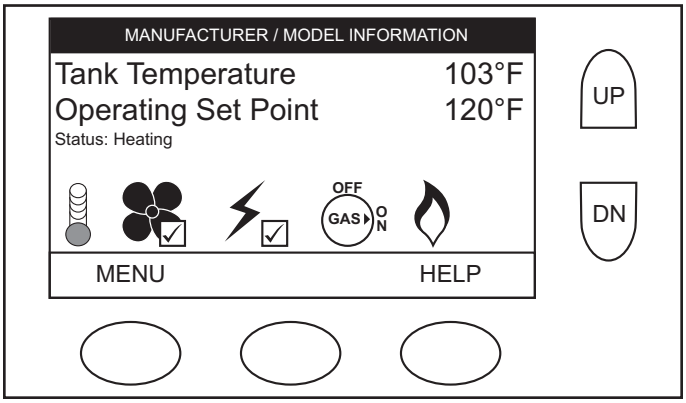


Figure 55

CONTROL SYSTEM OPERATION

OVERVIEW

The water heaters covered in this manual are equipped with an electronic control system that regulates water temperature inside the storage tank. Heating cycles and ignition are managed by the control system. The ECO (energy cut out), flame sensor, pressure switches and temperature probes are monitored by the control system. The Combustion Blower, igniter, 24 Volt Gas Valve and anode rods are all powered by the control system.

The main components of the control system are a UIM (user interface module) and a CCB (central control board). The UIM is located on the top front side of the water heater. The CCB is mounted on top of the water heater inside a protective enclosure. See Features And Components on page 7 for location of these and all water heater components.

CONTROL SYSTEM NAVIGATION

All operational information and user settings are displayed and accessed from the UIM. The UIM houses the control system's LCD (liquid crystal display) and five snap acting (momentary) user input buttons; an up, down and three (3) multi functional operational buttons below the LCD, see Figure 56.

User Input Buttons

- The up and down buttons are used to navigate menus and adjust user settings.
- The operational buttons are used to enter/exit menus, select menu items, activate adjustment modes and confirm or cancel new user settings. The operational buttons are multifunctional, their current function is defined by the text that appears directly above each button on the LCD screen.

THE DESKTOP SCREEN

During normal operation the control system will display the "Desktop" screen on the LCD which is the default screen. The control system will return to the Desktop screen when there are no active Fault or Alert conditions or when there has been no user input for several minutes.

- Manufacturer and water heater model information is displayed in Title Bar at the top of the Desktop screen. Menu titles are displayed in the Title Bar when navigating the control system menus.
- The first temperature shown on the Desktop screen, Tank Temperature, is the temperature of the water inside the water heater's storage tank.
- The second temperature shown on the Desktop screen is the Operating Set Point. The Operating Set Point is the temperature at which the control system will maintain the water inside the storage tank.
- Beneath the Operating Set Point is the "Status" line. The Status line shows the current operational state of the control system in real time, see Table 12 on page 46 for a description of the various operational states.
- The Desktop screen also displays animated "Status Icons" to convey operational information, see Table 11 on page 45 for descriptions of the Status Icons.

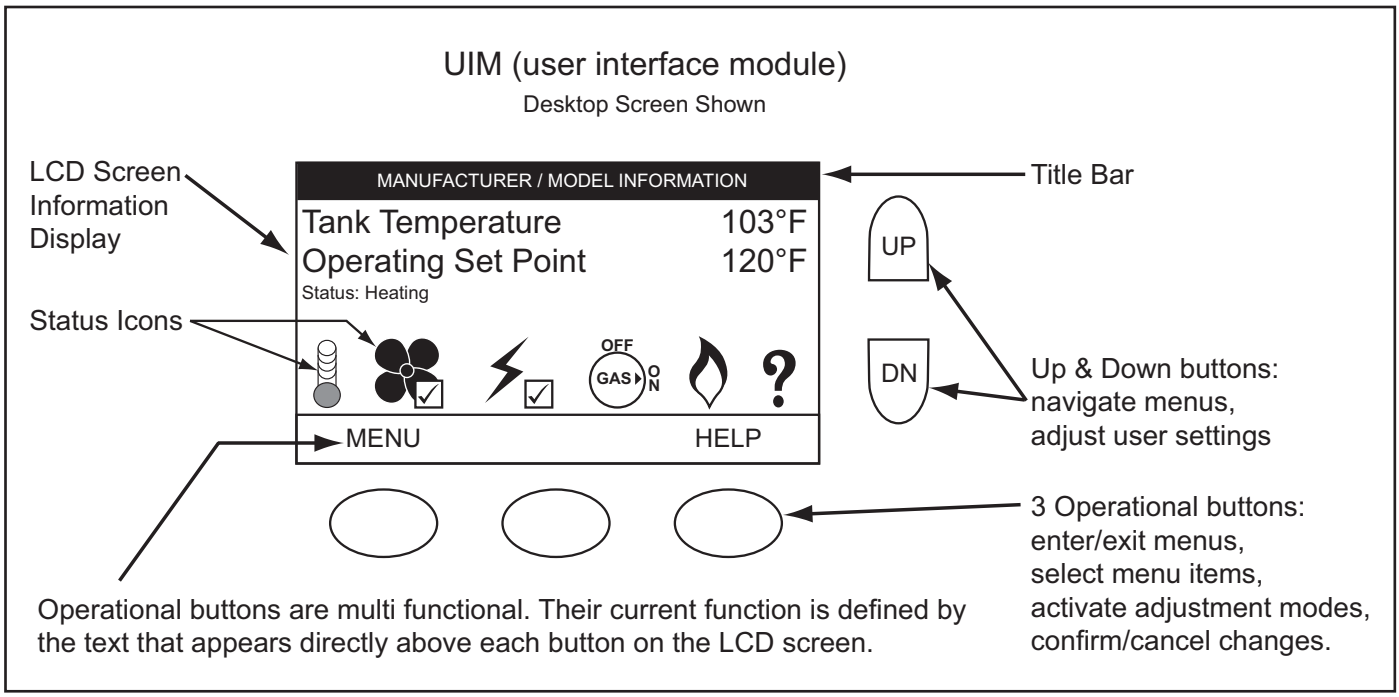

UIM (user interface module)
Desktop Screen Shown
LCD Screen Information Display
Status Icons
MANUFACTURER / MODEL INFORMATION
Tank Temperature 103°F
Operating Set Point 120°F
Status: Heating
OFF
GAS
ON
MENU
HELP
Title Bar
UP
DN
Up & Down buttons: navigate menus, adjust user settings
3 Operational buttons: enter/exit menus, select menu items, activate adjustment modes, confirm/cancel changes.
Operational buttons are multi functional. Their current function is defined by the text that appears directly above each button on the LCD screen.

Figure 56

STATUS ICONS

The Status Icons are displayed on the Desktop screen and convey operational and diagnostic information. The icons are described in the table below. See Figure 56 on page 44 and Sequence of Operation on page 58.

TABLE 11

Icon	Description
	Water temperature in the tank has fallen. Shaded area of the animated thermometer icon will rise and fall in response to water temperature in the storage tank as sensed from the Upper and Lower Temperature Probes. See beginning on page 8 and Figure 5 on page 10 for location of Temperature Probes.
	Water temperature in the tank has reached the Operating Set Point. The control system enters the Standby mode.
	The control is unable to initiate a heating cycle. This will happen whenever a Fault condition is detected by the control system or when the Enable/Disable circuit is an open circuit. For more information see Enable/Disable Circuit on page 41.
	The Combustion Blower is being energized.
	The Blower Prover pressure switch contacts have closed. The check mark icon is visual confirmation of contact closure. See beginning on page 8 for Blower Prover Switch location.
	The Hot Surface Igniter is being energized. See Figure 2 on page 7 for Hot Surface Igniter location.
	The igniter has been energized and the control system has sensed the required minimum igniter current. The check mark icon is visual confirmation of minimum igniter current. See the Sequence of Operation on page 58 for minimum current (AC amps) information.
	The 24 Volt Gas Valve is being energized.
	The control system has sensed flame at the Main Burner from the flame sensor. See the Sequence of Operation Flowchart on page 59 and Figure 2 on page 7.
	The control system has declared a Fault condition and must be inspected/serviced by a Qualified Service Agent. Fault message details can be viewed in the Current Fault menu. Heating operation is disabled (lock out) until the condition that caused the Fault is corrected. Power to the water heater must be cycled off and on to reset the control system. **NOTE:** Cycling power will not reset the control system if the condition that caused the Fault has not been corrected.
	The control system has declared an Alert condition and must be inspected/serviced by a Qualified Service Agent. The water heater will continue to operate during an Alert condition.

OPERATING STATES

The current operational state of the water heater is displayed on the Desktop screen as the "Status." The common operational states are described in the table below. See Figure 56 on page 44 and the Sequence of Operation on page 58.

TABLE 12

State	Description
Standby	The water heater is not in an active heating cycle. IE: the Tank Temperature is at or above the Operating Set Point.
Input Verification	The control system is conducting a diagnostic check at the beginning of a heating cycle.
Short Cycle Delay	The control system is waiting for a pre-defined time period to expire before initiating a heating cycle. This prevents "short-cycling" which can greatly accelerate wear on components such as the Hot Surface Igniter and Combustion Blower. **NOTE:** If the control system is in this operational state increase the Differential setting in the Temperatures menu to lengthen heating cycles.
Pre-Purge	The Combustion Blower is energized to flush residual flue gases from the combustion chamber prior to ignition.
Igniter Warm Up	The Hot Surface Igniter is energized and is currently warming up to ensure proper ignition. See the Sequence of Operation on page 58 for minimum current (AC amps) information.
Ignition Activation	The 24 Volt Gas Valve is energized and opens to allow fuel gas to flow to the Main Burner.
Ignition Verification	The control system is monitoring the flame sensor for the required minimum flame sensing current. See the Sequence of Operation on page 58 for minimum flame sensing current (DC micro amps) information.
Inter-Purge	The Combustion Blower is energized to flush residual fuel gas from the combustion chamber after a failed ignition attempt.
Heating	Ignition was successful, flame sensing current has been established. The water in the storage tank is being heated.
Post-Purge	The Combustion Blower is energized to flush residual flue gases from the combustion chamber at the end of a heating cycle.
Fault	The control system has detected a Fault condition. Heating operation is disabled until the Fault condition is corrected. Power to the water heater must be cycled off and on to reset the control system. **NOTE:** Cycling power will not reset the control system if the condition that caused the Fault has not been corrected.

CONTROL SYSTEM MENUS

From the Desktop screen pressing the Operational directly below "Menu" on the LCD will display the "Main Menu" this is where all control system menus are located. The table below describes the control system menus.

TABLE 13

Menu	Description
Temperatures	Most commonly accessed menu. Contains the Operating Set Point and Differential user settings.
Heater Status	This menus displays the current state of all pressure switches and the ECO (open/closed). The on/off status of the Combustion Blower, gas valve, igniter, flame sensor and other monitored water heater components are displayed in this menu.
Display Settings	Temperature units (°F or °C), the LCD appearance (brightness/contrast) and backlight delay user adjustable settings are located in this menu.
Heater Information	Elapsed time of operation, total heating cycle time, heating cycle count, heating on time along with UIM and CCB software revisions can be viewed in this menu.
Current Fault	Displays any current Alert or Fault messages.
Fault History	This control system menu retains a list of the last nine (9) Fault and Alert messages with a time stamp. The newest event will replace the oldest.
Fault Occurrence	This control system menu retains a running total of how many times each Fault condition has occurred since the water heater was first installed.
Restore Factory Defaults	This control system feature allows the user to restore control system user settings to their factory default settings. Display Settings preferences ARE NOT changed when factory defaults are restored.
Help Screens	Text based operational and user information explaining how to change user settings, navigate the control system menus and icon descriptions.

USER SETTINGS & CONTROL SYSTEM MENUS

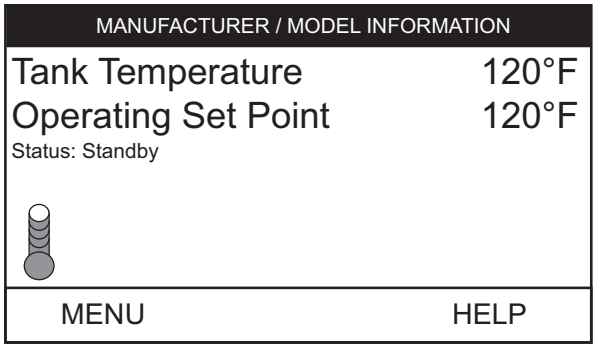
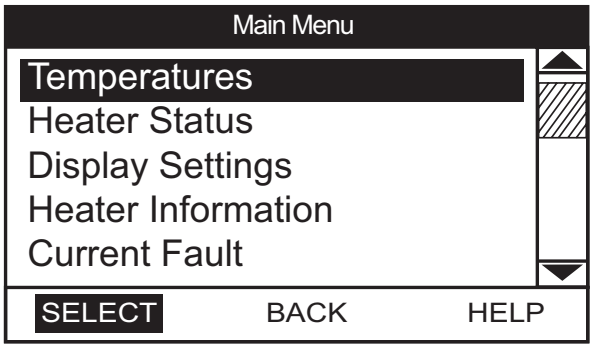
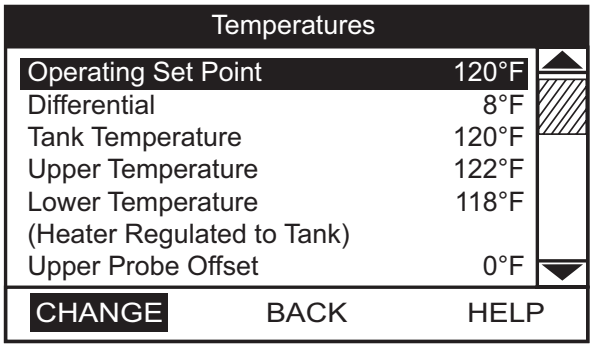
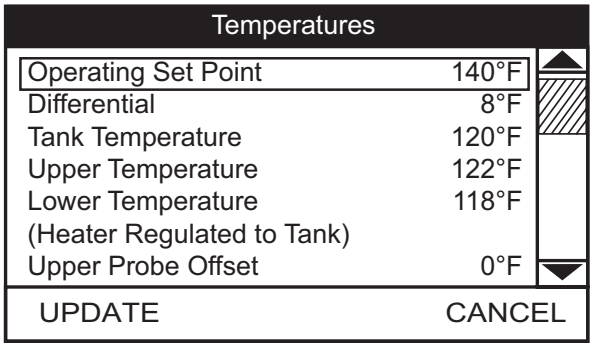
TEMPERATURES MENU

Operating Set Point And Differential Adjustment

The Operating Set Point is adjustable from 90°F (42°C) to 180°F (82°C). The factory setting is 120°F (49°C). The Differential is adjustable from 2° to 20°. The factory setting is 8°. These user settings are accessed from the Temperatures menu. The following instructions will explain how to adjust these settings and navigate the control system menus.

When the water temperature sensed by the control system from the two (upper and lower) Temperature Probes reaches the Operating Set Point the control system will end the heating cycle. A heating cycle will be activated again when the sensed water temperature drops below the Operating Set Point minus the Differential setting.

NOTE: Lower Differential settings may cause excessive heating cycles (short-cycling) which can cause premature failure of components such as the Hot Surface Igniter. Set the Differential at the highest setting which produces an acceptable hot water supply. Set the Operating Set Point to the lowest setting which produces an acceptable hot water supply for most efficient use.

DESCRIPTION/ACTION	DISPLAY
From the Desktop screen, press the Operational Button under MENU. The "Main Menu" screen will be displayed.	
The Main Menu is where all control system menus are listed, see Table 13 on page 46 for a complete list and description of control system menus. Use the Up and Down Buttons to view all control system menus from the Main Menu. With Temperatures menu selected (highlighted in black) in the Main Menu screen, press the Operational Button under “SELECT” to enter the Temperatures menu. If the Temperatures menu is not selected use the Up and Down Buttons to select this menu item.	
With the Operating Set Point selected in the Temperatures menu, press the Operational Button underneath “CHANGE” to activate the adjustment mode for this menu item. If Operating Set Point is not selected use the Up and Down Buttons to select this menu item. **NOTE:** Higher Temperature settings increase wear and operating costs. Set the Operating Set Point to the lowest setting which produces an acceptable hot water supply. This will always provide the most energy efficient operation and longer life.	
With the adjustment mode for the Operating Set Point activated the selection bar will change from a black fill to a black outline. Use the Up and Down Buttons to change the current setting. Press the Operational Button under "UPDATE" to save the new setting. Press the Operational Button under "CANCEL" to discard changes and return to the previously saved setting. **NOTE:** Use this same procedure to change the Differential setting and other adjustable user settings in the control system menus.	

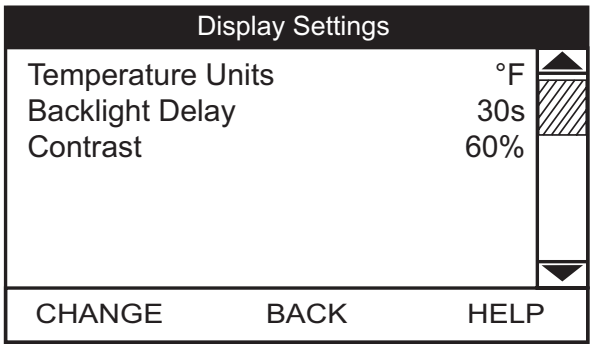
TEMPERATURES MENU (CONT)

DESCRIPTION/ACTION	DISPLAY
• **Tank Temperature** - non adjustable - control system sensed temperature (averaged from upper and lower temperature probes). • **Upper Temperature** - non adjustable - control system sensed temperature from the Upper Temperature Probe. • **Lower Temperature** - non adjustable - control system sensed temperature from the Lower Temperature Probe. • **(Heater Regulated to Tank)** - non adjustable - configuration information. • **Upper Probe** & **Lower Probe Offset** - adjustable user setting, range -5° to +5° (factory setting 0°). **NOTE:** These settings should only be used if the hot water supply temperature varies greatly from the Operating Set Point setting. The Upper and Lower Probe Offsets are used to calibrate control system temperature sensing. This can improve the precision of temperature control in the storage tank and at points of use. This feature can also be used to compensate for building recirculation loops (hot water returning to the storage tank) that may cause the heating cycles to terminate prematurely. Example: If the current sensed temperature from a temperature probe is 120°F (49°C) and the Offset setting for that probe is adjusted to a value other than 0°, the control system would calibrate or “offset” the sensed temperature from the probe and the averaged tank temperature. Heating cycles would be activated and deactivated based on the calibrated (offset) temperature. These settings are adjusted in the same way described for the Operating Set Point And Differential Adjustment on page 47.	Top of Menu Temperatures Operating Set Point 140°F Differential 8°F Tank Temperature 120°F Upper Temperature 122°F Lower Temperature 118°F (Heater Regulated to Tank) Upper Probe Offset 0°F CHANGE BACK HELP Bottom of Menu Temperatures Differential 8°F Tank Temperature 120°F Upper Temperature 122°F Lower Temperature 118°F (Heater Regulated to Tank) Upper Probe Offset 0°F Lower Probe Offset 0°F CHANGE BACK HELP

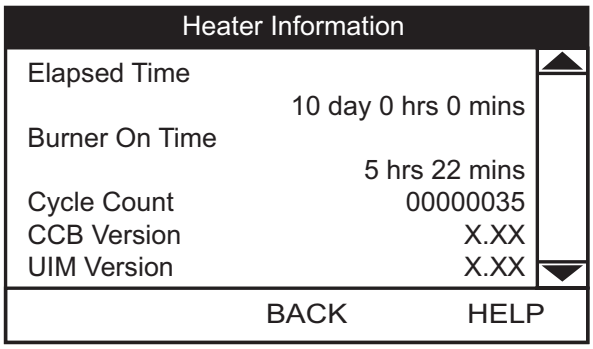
HEATER STATUS MENU

DESCRIPTION/ACTION	DISPLAY
Select Heater Status from the Main Menu and press the Operational Button under "SELECT" to enter this menu. This menu contains non adjustable operational information. Use the Up & Down Buttons to navigate the menu. • **Status** - displays the current Operating State, see Table 12 on page 46. • **ECO Contact**, **Low Gas PS**, **Blocked Inlet PS**, **Blocked Outlet PS**, **Blower Prover PS** - displays the current state of the switch contacts; open or closed. • **Blower On**, **Igniter On**, **Gas Valve On** - displays whether or not the control system is currently energizing these water heater components; yes = energized, no = de-energized. • **Igniter Current** - displays whether or not the control system has detected the required minimum current, see Sequence of Operation on page 58 . • **Flame Detected** - displays whether or not the control system has detected Main Burner flame during ignition from the flame sensor. • E**xternal Input Enable** - displays whether or not the S1 dipswitches have been configured to activate the enable/ disable circuit, see Enable/Disable Circuit on page 41. • **Ignition Trials** - displays whether or not the S1 dipswitches have been configured to allow 1 or 3 trials for ignition before declaring an "Ignition Failure" Fault condition, see the CCB - Central Control Board Layout on page 67.	Top of Menu Heater Status Status Standby ECO Contact Closed Low Gas PS Closed Blocked Inlet PS Closed Blocked Outlet PS Closed Blower Prover PS Open Blower On No BACK HELP Bottom of Menu Heater Status Blower On No Igniter On No Igniter Current No Gas Valve On No Flame Detected No External Input Enable No Ignition Trials 3 BACK HELP

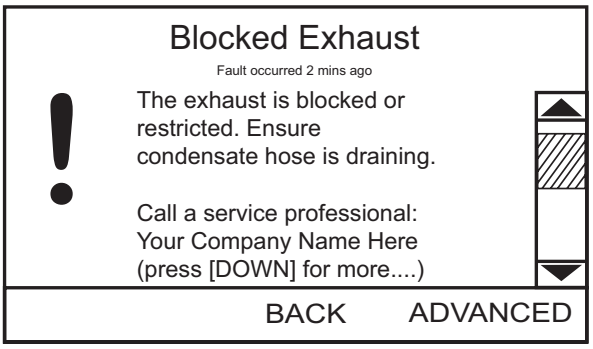
DISPLAY SETTINGS

DESCRIPTION/ACTION	DISPLAY
Select Display Settings from the Main Menu and press the Operational Button under "SELECT" to enter this menu. This menu contains adjustable display options for viewing information on the UIM's LCD screen. Use the Up & Down Buttons to navigate the menu. • **Temperature Units** - Adjustable user setting that changes temperature units display to Celsius °C or Fahrenheit °F. • **Backlight Delay** - Adjustable user setting that determines how long the UIM's LCD backlight remains illuminated after a key has been pressed. Available settings are; Always Off, 10, 30 or 60 seconds and Always On. • **Contrast** - Adjustable user setting to adjust the UIM's LCD screen contrast between text and background. **NOTE:** These settings are adjusted in the same way described for the Operating Set Point And Differential Adjustment on page 47.	

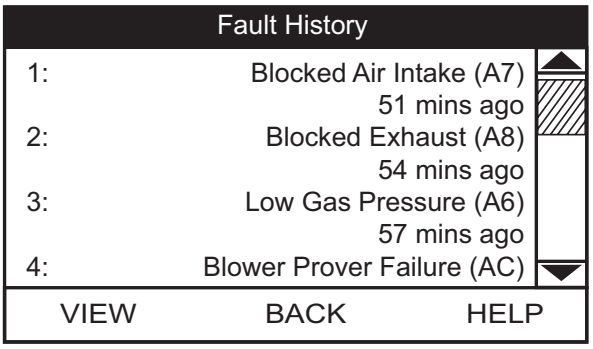
HEATER INFORMATION

DESCRIPTION/ACTION	DISPLAY
Select Heater Information from the Main Menu and press the Operational Button under "SELECT" to enter this menu. This menu contains non adjustable operational information. • **Elapsed Time** - Total accumulated time the control system (water heater) has been energized. • **Burner On Time** - Total accumulated time the control system has been in the heating operating state; burner run time. • **Cycle Count** - Total accumulated count of heating cycles. • **CCB Version** - Software version for central control board. • **UIM Version** - Software version for user interface module. **NOTE:** Historical data is stored in the CCB's memory. If this CCB is replaced during servicing the historical data on the CCB being replaced will be lost. The data stored in the new circuit board will no longer reflect the entire history of the water heater. The Elapsed Time, Burner On Time and Cycle Count indicate age, usage and wear. If the Cycle Count per day is high (divide cycle count by days to determine cycles per day) or the cycle duration is short (determine burner on time total minutes, divide burner on time total minutes by cycle count) consider rasing the Differential setting to avoid short cycling and excessive component wear, see Operating Set Point And Differential Adjustment on page 47. This historical data can also be used to assist facilities managers in forecasting planned replacement of equipment to help avoid lengthy and costly hot water supply interruptions.	

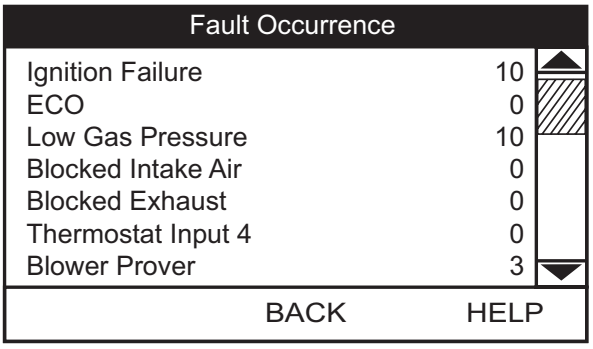
CURRENT FAULT

DESCRIPTION/ACTION	DISPLAY
Select Current Fault from the Main Menu and press the Operational Button under "SELECT" to enter this menu. This menu contains non adjustable operational information. Use the Up & Down Buttons to navigate the menu. This menu contains the current Fault or Alert error message. The time the Fault or Alert message occurred appears directly below. A brief description of what causes the particular Fault or Alert condition appears below that. Pressing the Operational Button under "ADVANCED" will give more detailed service information and a list of possible causes for the Fault or Alert condition. See Fault and Alert Messages on page 62 for more detailed information and diagnostic procedures. If there is no Fault or Alert condition active this menu will not contain any information, "(none)" will be shown next to Current Fault in the Main menu.	

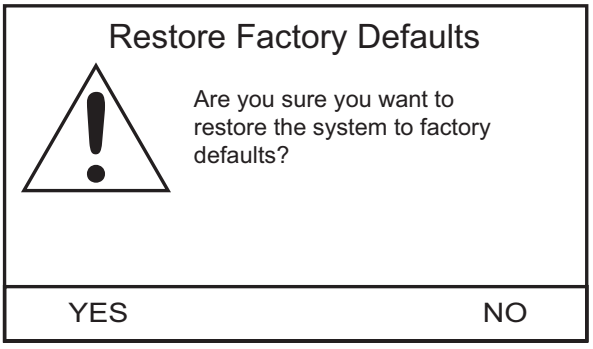
FAULT HISTORY

DESCRIPTION/ACTION	DISPLAY
Select Fault History from the Main Menu and press the Operational Button under "SELECT" to enter this menu. This menu contains non adjustable operational information. Use the Up & Down Buttons to navigate the menu. This menu contains a list of the last nine (9) Fault and Alert messages with a time stamp. The newest event will replace the oldest. Press the Operational Button under "VIEW" to view details for each Fault or Alert message stored.	

FAULT OCCURRENCE

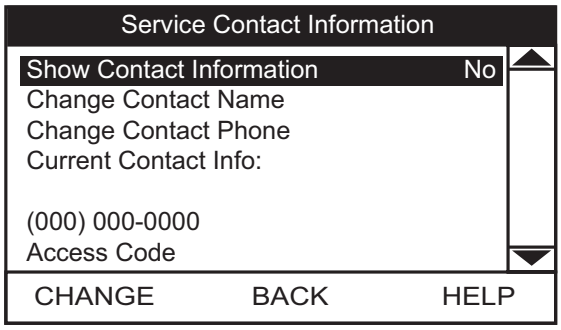
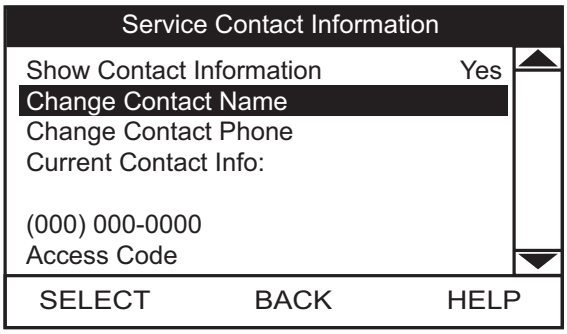
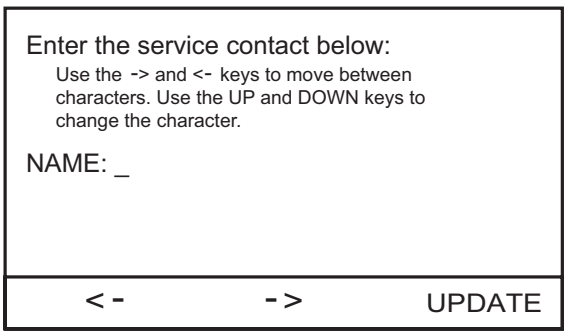
DESCRIPTION/ACTION	DISPLAY
Select Fault Occurrence from the Main Menu and press the Operational Button under "SELECT" to enter this menu. This menu contains non adjustable operational information. Use the Up & Down Buttons to navigate the menu. This menu contains a running total of how many times each Fault condition has occurred since the water heater was first installed. **NOTE:** Historical data is stored in the CCB's memory. If this CCB is replaced during servicing the historical data on the CCB being replaced will be lost. The data stored in the new circuit board will no longer reflect the entire history of the water heater.	

RESTORE FACTORY DEFAULTS

DESCRIPTION/ACTION	DISPLAY
Select Restore Factory Defaults from the Main Menu and press the Operational Button under "SELECT" to enter this menu. To restore the adjustable user settings to their factory default settings press the Operational Button underneath “YES.” The display will show text confirming the factory default settings have been restored. Press the Operational Button underneath “BACK” to exit the Restore Factory Defaults menu.	

SERVICE CONTACT INFORMATION

The control system has a discrete menu that Installing contractors and/or service agents can access to enter contact information for their customers. This contact information will be displayed with all Fault and Alert messages.

DESCRIPTION/ACTION	DISPLAY
From the Desktop Screen (see Figure 56 on page 44) press and hold down the middle (unmarked) Operational Button for 30 seconds and then release it. This will launch a discrete menu where personalized contact information can be entered. Using the UP and DOWN buttons select (highlighted in black) the "Show Contact Information" menu item. Press the Operational Button under "CHANGE" to activate the adjustment mode for this parameter.	
With the adjustment mode for "Show Contact Information" activated the selection bar will change from a black fill to a black outline. Use the Up and Down Buttons to change the setting from "No" to "Yes" and press the Operational Button underneath "UPDATE" to save the new setting. **NOTE:** The Access Code at the bottom of the Service Contact Information screen is for manufacturing engineering purposes only. There are no user settings or information accessed through this menu item.	
Using the UP and DOWN buttons select (highlighted in black) the "Change Contact Name" menu item. Press the Operational Button under "SELECT" to open the Change Contact Name menu.	
Follow the on screen instructions to enter your name or the name of your company. There is a maximum of 20 character spaces for this purpose. When finished press the Operational Button "UPDATE" to save the new Contact Name. The control system will return to the discrete menu.	
Using the UP and DOWN buttons select (highlighted in black) the "Change Contact Phone" menu item and press the Operational Button under "SELECT". Follow the on screen instructions to enter a new Contact Phone number and press the Operational Button under "UPDATE" to save the new phone number. When the new Contact Name and Contact Phone number have both been updated, press the Operational Button under "BACK" to return to the Desktop screen.	

START UP

PRIOR TO START UP

Installation and start up of this water heater requires abilities and skills equivalent to that of a licensed tradesman in the field involved, see Qualifications on page 6.

Do not place the water heater in operation if any part has been under water. Immediately call a qualified service technician to inspect the water heater and to replace any part of the control system and any gas control which has been under water.

Light the water heater in accordance with the Lighting and Operation Instruction label on the water heater and in this manual beginning on page 56.

The water heaters covered by this manual are equipped with an electronic control system (see page 44) which automatically sequences the Combustion Blower, pre and post purging of the combustion chamber, the Hot Surface Igniter, the 24 Volt Gas Valve, Main Burner ignition, and flame sensing. The control system will lock out after three unsuccessful ignition attempts.

Before attempting start up, thoroughly study and familiarize yourself with the exact Sequence Of Operation, see the written Sequence of Operation on page 58 and the Sequence Of Operation Flow Chart on page 59.

Be certain that the water heater is full of water, that air is purged from the gas and water lines and that there are no leaks in the gas and water lines. Ensure all inlet water valves are open.

FILLING THE WATER HEATER

Follow these steps to fill the water heater prior to start up.

1. Close the heater drain valve.
2. Open a nearby hot water faucet to permit the air in the system to escape.
3. Fully open the cold water inlet valve allowing the piping and water heater to fill with water.
4. Close the hot water faucet opened in Step 2 as water starts to flow.

SUPPLY GAS LINE PURGING

⚠WARNING

Fire or Explosion Hazard

- Gas line purging is required with new piping or systems in which air has entered.
- To avoid risk of fire or explosion purge discharge must not enter into confined areas or spaces where ignition can occur.
- The area must be well ventilated and all sources of ignition must be deactivated or removed.
- Use only the gas shown on the water heater rating label.
- Keep ignition sources away from faucets after extended periods of non-use.

Read instruction manual before installing, using or servicing water heater.

1. Close the Main Gas Shutoff Valve, see Figure 52 on page 39.
2. Purge all air from the supply gas line up to the water heater's Main Gas Shutoff Valve.
3. When all air has been purged from the supply gas line, tighten all supply gas line connections.
4. Check for gas leaks, see Gas Line Leak Testing on page 40, and repair any leaks found.

INITIAL START UP

REQUIRED TEST EQUIPMENT

- Two U-tube manometers, recommended ranges; 0-14" W.C. (0-3.5 kPa) and 0-35" W.C. (0-8.7 kPa) or pressure gauges.
- Two digital manometers can be used in place of U-tube manometers or pressure gauges. Recommended ranges; -14.00 to +14.00" W.C. (0-3.5 kPa) resolution 0.01" W.C. and 0-35" W.C. (0-8.7 kPa) resolution 0.10" W.C.

NOTE: All test equipment must be acclimated to ambient temperature before calibration and use.

PREPARATION

1. Using the control system menus, change the Operating Set Point to the lowest temperature setting, see Operating Set Point And Differential Adjustment on page 47.
2. Turn the water heater's on/off switch to the "off" position.
3. Close the Main Gas Shut Off Valve, see Figure 52 on page 39.
4. Wait five (5) minutes for any residual gas to clear.
5. Connect one manometer (higher range) to an available test port for the supply gas pressure to the water heater:

   On BTH 120 and 150 models there is a 1/8" NPT Tee fitting and pipe nipple installed for the Low Gas Pressure switch on the inlet side of the 24 Volt Gas Valve with a 1/8" pipe plug for this purpose. Remove the 1/8 inch pipe plug from the bottom of the Tee fitting and install a barb fitting to connect the manometer sensing tube, see Figure 58 on page 53.

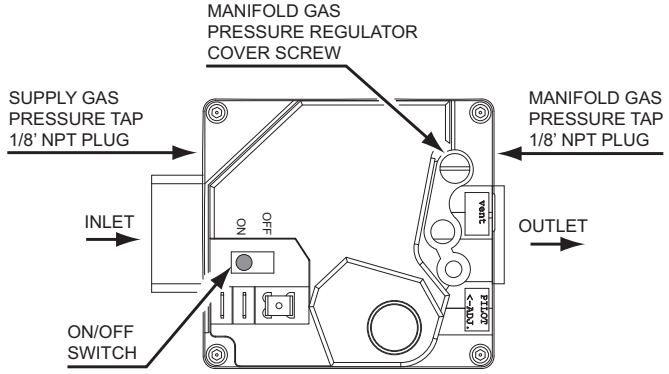
   On BTH 199 and 250 models there are test ports for supply and manifold gas pressure readings on the gas valve. Using a small flat tip pocket screw driver - open the needle valve inside the supply gas pressure test port one full turn only; turn the needle valve screw counter-clockwise to open the valve. Slide the manometer sensing tube over the top of the test port, see Figure 59 and Figure 60 on page 53.
6. Connect one manometer (lower range) to an available test port for manifold gas pressure to the Main Burner:

   BTH 120 & 150 models: remove the 1/8 inch pipe plug from the body of the gas valve on the outlet side and install a barb fitting to connect the manometer sensing tube, see Figure 57 on page 53.

   BTH 199 & 250 models: Using a small flat tip pocket screw driver - open the needle valve inside the manifold gas pressure test port one full turn only; turn the needle valve screw counter-clockwise to open the valve. Slide the manometer sensing tube over the top of the test port, see Figure 59 and Figure 60 on page 53.
7. Open the Main Gas Shutoff Valve.
8. Measure and record the supply gas pressure, this is a "static" supply gas pressure reading; while the water heater is not firing. Adjust supply gas pressure as necessary, see Supply Gas Pressure Adjustment on page 54.

LIGHTING THE WATER HEATER

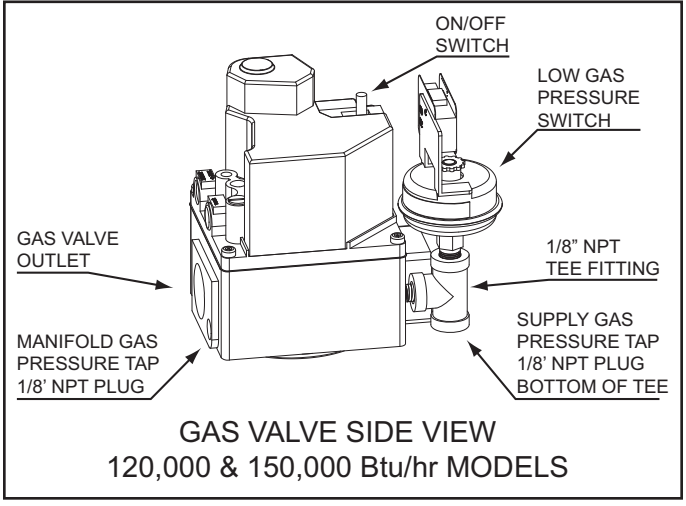
1. BTH 120 & 150 models: turn the on/off switch on the gas valve to the "on" position, see Figure 57 and Figure 58.
2. Turn the water heater's on/off switch to the "on" position.
3. Wait for the control system to complete its boot up sequence. The Desktop screen showing the current Operating Set Point and Tank Temperature will be displayed on the control system's LCD when the boot up sequence is complete.
4. Using the control system menus and UIM (user interface module), change the Operating Set Point to a setting higher than the current tank temperature displayed on the control system LCD plus the Differential setting to activate a call for heating. See Control System Operation on page 44.



GAS VALVE TOP VIEW
120,000 & 150,000 Btu/hr MODELS

Figure 57

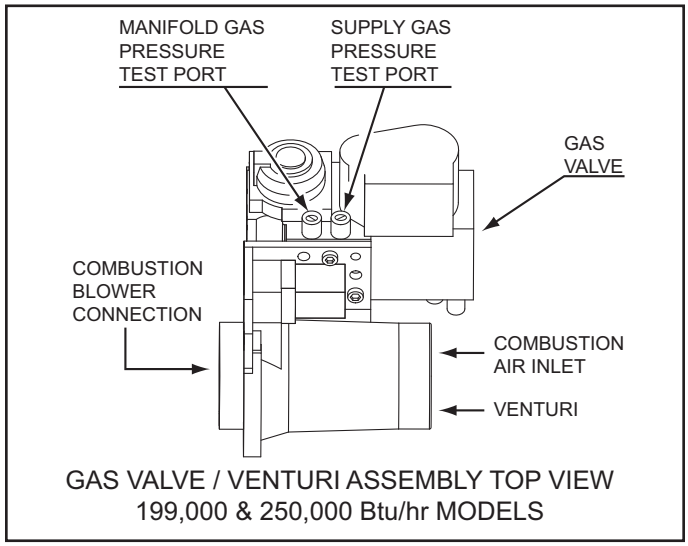
5. Record the manifold gas pressure when the 24 Volt Gas Valve is energized and the Main Burner is ignited, the animated gas valve icon will be displayed on the Desktop screen of the control system's LCD when the control system energizes the 24 Volt Gas Valve, a animated flame icon will appear when Main Burner ignition is successful, see the Status Icons descriptions in Table 11 on page 45.



GAS VALVE SIDE VIEW
120,000 & 150,000 Btu/hr MODELS

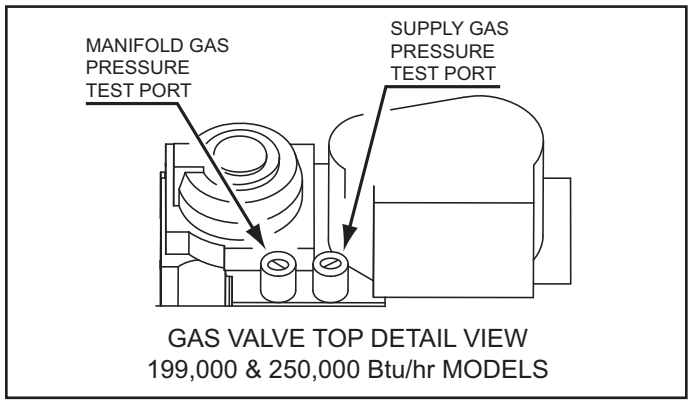
Figure 58

6. Compare the actual manifold gas pressure reading recorded above to the required minimum/maximum values given in Table 4 on page 14. Adjust manifold gas pressure as necessary, see Manifold Gas Pressure Adjustment on page 54.
7. Record the supply gas pressure when the 24 Volt Gas Valve is energized and the Main Burner is ignited. This is a "dynamic" gas pressure reading; while the water heater is firing.
8. Compare the actual supply gas pressure reading recorded above to the required minimum/maximum values given in Table 4 on page 14. Adjust supply gas pressure as necessary, see Supply Gas Pressure Adjustment on page 54.
9. When complete turn off gas to the water heater, see instructions on page 55. Disconnect manometers and replace all pipe plugs removed for testing. Ensure all test port needle valves opened during testing are completely closed.



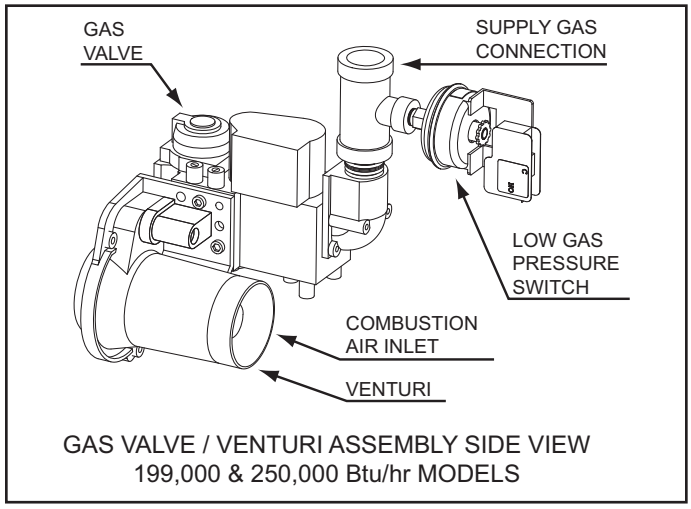
GAS VALVE / VENTURI ASSEMBLY TOP VIEW
199,000 & 250,000 Btu/hr MODELS

Figure 59



GAS VALVE TOP DETAIL VIEW
199,000 & 250,000 Btu/hr MODELS

Figure 60



GAS VALVE / VENTURI ASSEMBLY SIDE VIEW
199,000 & 250,000 Btu/hr MODELS

Figure 61

SUPPLY GAS PRESSURE ADJUSTMENT

⚠ WARNING

Fire and Explosion Hazard

- Do not use water heater with any gas other than the gas shown on the rating label.
- Excessive gas pressure to gas valve can cause serious injury or death.
- Turn off gas lines during installation.
- Contact a qualified installer or service agency for installation and service.

Supply gas pressure shall be measured while the water heater is not firing (static pressure) AND while the water heater is firing at full capacity (dynamic pressure).

If the supply gas pressure to the water heater is not between the required minimum and maximum values given in Table 4 on page 14 adjust the supply gas regulator as necessary. Adjust the supply gas regulator(s) per the regulator manufacturer's instructions to achieve the required "static" and "dynamic" supply gas pressure.

Multiple Appliance Installations:

In multiple water heater installations or in installations where the installed water heater(s) share a common gas supply main with other gas fired appliances; the supply gas pressures shall be measured at each water heater with all gas fired appliances connected to a common main firing at full capacity.

On multiple water heater installations the supply gas line regulators shall be adjusted to provide gas pressure to each water heater within the minimum and maximum supply pressure requirements listed in Table 4 on page 14 with all gas fired appliances connected to a common gas main firing at full capacity.

NOTE: A pressure drop of more than 1.5" W. C. (0.37 kPa) when the Main Burner ignites is an indication of an inadequate supply of gas and can lead to ignition failure, rough starts and/or rough operation. If a drop of more than 1.5" W. C. (0.37 kPa) in supply gas pressure occurs when the Main Burner ignites, ensure the supply gas lines and regulator(s) are properly sized and installed. See the requirements for Supply Gas Regulator and Supply Gas Line on page 14. See Supply Gas Line Installation on page 39 and Supply Gas Regulator on page 14. Ensure all requirements and installation instructions are maintained.

MANIFOLD GAS PRESSURE ADJUSTMENT

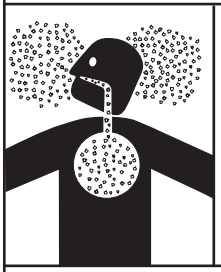
⚠ WARNING

Fire and Explosion Hazard

- Under no circumstances should the input exceed the rate shown on the water heater's rating label.
- Overfiring could result in fire or explosion.
- Gas and carbon monoxide detectors are available.

⚠ WARNING

Breathing Hazard - Carbon Monoxide Gas



- Under no circumstances should the input exceed the rate shown on the water heater's rating label.
- Overfiring could result in damage to the water heater and sooting.
- Gas and carbon monoxide detectors are available.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

Ensure the "dynamic" supply gas pressure is above the minimum requirements in Table 4 on page 14 before any adjustments are made to the manifold gas pressure. Attempts to adjust manifold gas pressure during periods of low supply gas pressure could result in overfiring when the supply gas pressure returns to normal. See Supply Gas Pressure Adjustment on this page.

NOTE: Manifold gas pressure is non-adjustable on BTH 199 and BTH 250 models. The manifold gas pressure on these models is factory set and cannot be field adjusted. If the manifold gas pressure readings taken on these models is off by more than ± 0.3" W. C. from the listed values in Table 4 on page 14 call the technical support phone number listed on the back cover of this manual for further assistance.

Follow the steps below to adjust the manifold gas pressure on BTH 120 and BTH 150 models:

1. Follow the instructions for Initial Start Up on page 52 to connect manometers to the supply and manifold gas pressure taps and to start the water heater.
2. Remove the manifold gas pressure regulator cover screw, see Figure 57 on page 53.
3. Using a small flat tip screw driver turn the adjustment screw clockwise to increase manifold gas pressure and counter clockwise to decrease manifold gas pressure.

   NOTE: Turn the manifold gas pressure adjustment screw in small increments (no more than 1/4 turn) and allow the manifold gas pressure to stabilize for several minutes before making further adjustments.
4. Replace the gas pressure regulator cover screw.
5. Cycle the burner on and off several times to check operation.

CHECKING THE FIRING RATE

If firing rate adjustment is required follow these instructions to determine the actual firing rate of the water heater:

1. Ensure there are no other gas fired appliances connected to the gas meter firing during this test.
2. Contact the gas supplier to determine the heating value, in Btu per cubic foot, of the gas supply.
3. Connect a manometer to the manifold gas pressure tap. Follow the instructions for Initial Start Up on page 52.
4. Start the water heater and ensure it is firing.
5. Check the manifold gas pressure, refer to Table 4 on page 14 for correct pressure. See Manifold Gas Pressure Adjustment on page 54 if adjustment is necessary.
6. Locate the gas meter serving the water heater.
7. Time how long (in seconds) it takes for one cubic foot of gas to be used while the water heater is firing with a stop watch.
8. Use the formula below to “clock” the gas meter and determine the actual firing rate of the water heater based on the heating value (Btu per cubic foot) of the gas supply:

$$\frac{3600}{T} \times H = \text{Btu/hr}$$

Example:

$$\frac{3600}{12.6} \times 1050 = 300{,}000 \text{ Btu/hr (87.9 kW)}$$

- 3600 = seconds in one hour.
- T = time, in seconds, to burn one cubic foot of gas.
- H = heating value of gas in Btu per cubic foot.
- Btu/hr = actual firing rate of the water heater.

NOTE: 1050 Btu per cubic foot is a standard value for natural gas. Standard propane gas Btu content is 2500 Btu per cubic foot. Btu values may change in certain areas and at high elevations. Check with the local gas utility company.

TO TURN OFF GAS

1. Change the Operating Set Point to the lowest temperature setting, see Operating Set Point And Differential Adjustment on page 47.
2. When the water heater has completed its shut down sequence and enters the standby mode, turn the water heater’s on/off switch to the “off” position.
3. Close the Main Gas Shutoff Valve, see Figure 52 on page 39.

HIGH ALTITUDE INSTALLATIONS

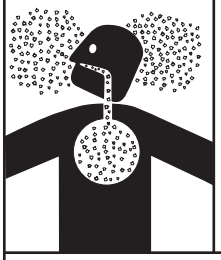
⚠ WARNING

Fire and Explosion Hazard

- Under no circumstances should the input exceed the rate shown on the water heater’s rating label.
- Overfiring could result in fire or explosion.
- Gas and carbon monoxide detectors are available.

⚠ WARNING

Breathing Hazard - Carbon Monoxide Gas



- Under no circumstances should the input exceed the rate shown on the water heater’s rating label.
- Overfiring could result in damage to the water heater and sooting.
- Gas and carbon monoxide detectors are available.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

BTH 120 and BTH 150 models are certified for use without modification for altitudes up to 7,700 feet (2,347 m).

BTH 199 and BTH 250 models are certified for use without modification for altitudes up to 10,100 feet (3,078 m).

Most gas utility companies de-rate their gas for high altitudes, making it unnecessary to install high altitude orifices.

For installations above the certified elevations listed above call the technical support phone number listed on the back cover of this manual for further technical assistance. Call the local gas or utility company to verify Btu per cubic foot content before calling for technical assistance and have that information available.

NOTE: The actual firing rate of the water heater must not exceed the input rating on the water heater's rating label under any circumstances.

NOTE: Due to the input rating reduction at high altitudes, the output rating of the appliance is also reduced and should be compensated for in the sizing of the equipment for applications.

LIGHTING THE WATER HEATER

LIGHTING & OPERATION LABELS

The instruction label below is affixed to the water heater's covered by this manual at the factory and must be followed when lighting and operating the water heater.

BTH 120 AND BTH 150 MODELS ONLY

FOR YOUR SAFETY READ BEFORE OPERATING

WARNING **IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.**

FLAMMABLE

A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.

B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

"WHAT TO DO IF YOU SMELL GAS"

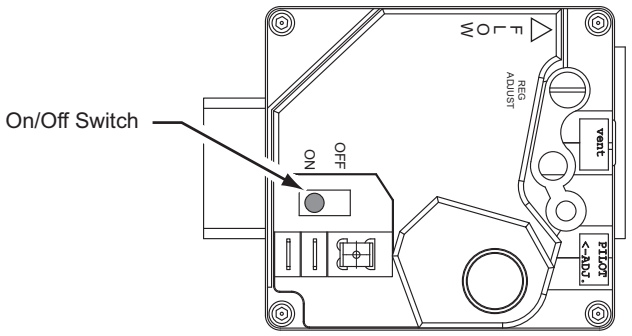
- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any telephone in your building.
- Immediately call your gas supplier from a neighbor's telephone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in fire or explosion.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above on this label.
2. Set thermostat to lowest setting.
3. Turn off all electrical power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Move "Off/On" switch to the "Off" position. Wait five (5) minutes to clear out any gas. If you then smell gas, STOP! Follow "B" in the safety information above on this label. If you don't smell gas, go on to the next step.
6. Move "Off/On" switch to the "On" position.
7. Turn on all electrical power to the appliance.
8. Set thermostat to desired setting.
9. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.



TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electrical power to the appliance if service is to be performed.
3. MOve "Off/On" switch to the "Off" position. Do not force.

LIGHTING THE WATER HEATER

LIGHTING & OPERATION LABELS

The instruction label below is affixed to the water heater's covered by this manual at the factory and must be followed when lighting and operating the water heater.

BTH 199 AND BTH 250 MODELS ONLY

FOR YOUR SAFETY READ BEFORE OPERATING

WARNING **IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.**

FLAMMABLE

BEFORE OPERATING: ENTIRE SYSTEM MUST BE FILLED WITH WATER AND AIR PURGED FROM ALL LINES

A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.

B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

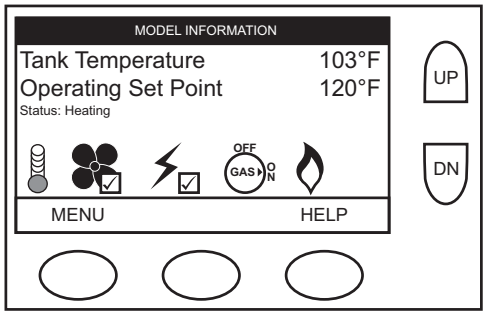
"WHAT TO DO IF YOU SMELL GAS"

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any telephone in your building.
- Immediately call your gas supplier from a neighbor's telephone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in fire or explosion.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS



ON/OFF SWITCH

1. **STOP!** Read the safety information above on this label.
2. Set the ON/OFF switch on the control panel to the "ON" position.
3. Set the thermostat to the lowest setting.
4. Set the ON/OFF switch on the control panel to the "Off" position.
5. This appliance is equipped with an ignition device which automatically lights the burner. DO NOT TRY TO LIGHT THE BURNER BY HAND.
6. Wait five (5) minutes to clear out any gas. If you then smell gas, STOP! Follow "B" in the safety information above on this label. If you don't smell gas, go on to the next step.
7. Turn on all electrical power to the appliance.
8. Set the ON/OFF switch on the control panel to the "ON" position.
9. Set thermostat to desired setting. **CAUTION: Hotter water increases the risk of scald injury. Consult the instruction manual before changing temperature.**
10. If the appliance will not operate, follow the instructions "TO TURN OFF GAS TO APPLIANCE" and call your service technician or gas supplier. **WARNING: TURN OFF ALL ELECTRICAL POWER BEFORE SERVICING.**

TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Set the ON/OFF switch on the control panel to the "OFF" position.
3. Turn off all electrical power to the appliance if service is to be performed.

TROUBLESHOOTING

INSTALLATION CHECKLIST

The list below represents some of the most critical installation requirements that, when overlooked, often result in operational problems, down time and needless parts replacement. This is not a complete list. Before performing any troubleshooting procedures use the list below to check for installation errors. Costs to correct installation errors are not covered under the limited warranty. Ensure all installation requirements and instructions in this manual have been maintained and followed.

WATER HEATER LOCATION

1. Ensure proper clearances to combustibles are maintained and there is sufficient room to service the water heater. See Clearance To Combustible Materials on page 13.
2. Ensure the area is free of corrosive elements and flammable materials. See the instructions on page17.

VENTING

3. Ensure the intake air and/or vent (exhaust) piping is the correct size for the installed length. See Venting Requirements on page 24.
4. Ensure the maximum equivalent feet of pipe has not been exceeded for the intake air and/or vent pipe. See Table 7 on page 24.
5. Ensure the maximum number of elbows has not been exceeded in the intake air and/or vent pipe. See Venting Requirements on page 24.
6. Ensure the intake air screen has been removed from the intake air connection on the water heater when installing the water heater in a Direct Vent configuration. See Figure 19 on page 26.
7. Ensure all exterior clearances for the intake air, vent and concentric terminations are maintained. See Vertical Termination Installation on page 27, Sidewall Termination Installation on page 29 and Concentric Termination Installation on page 30. These clearances and those cited by local and national codes must be maintained.

GAS SUPPLY AND PIPING

8. Ensure a supply gas regulator has been installed for each water heater. See the requirements for a Supply Gas Regulator on page 14 and Supply Gas Regulator on page 14.
9. Ensure the supply gas line to each water heater meets the minimum supply gas line size requirements. See the requirements for the Supply Gas Line on page 14 and the installation instructions on page 39 and 40.

CONDENSATE DRAIN

10. Ensure the condensate drain is properly connected to the exhaust elbow on the water heater and draining freely to a suitable floor drain. See Figure 9 on page 17 and Condensate Drain Installation on page 38.

ELECTRICAL CONNECTIONS

11. Ensure the power supply connections to the water heater are polarity correct. See the requirements for the Power Supply on page 14 and Electrical Wiring on page 41.
12. Ensure the water heater is properly grounded. Flame sensing requires an adequate earth ground. If the water heater is not properly grounded it will cause Ignition Failure.

SEQUENCE OF OPERATION

Read the Sequence of Operation below before attempting to correct any operational problems. Refer to the Features And Components section beginning on page 7 for the location of various water heater components described below. See the Sequence Of Operation Flow Chart on page 59 also.

1. When the control system is first powered, during boot up, it will display water heater model information during initialization. After a few moments the control system LCD which is part of the UIM (user interface module) will display the default screen known as the "Desktop" screen.
2. If the control system determines that the actual water temperature inside the tank is below the programmed Operating Set Point minus the Differential setting, a heating cycle is activated.
3. The control system then performs selected diagnostic system checks. This includes confirming the low gas pressure, blocked exhaust, blocked intake and ECO (energy cut out) switch contacts are closed. The Blower Prover Switch contacts are confirmed open.
4. If all diagnostic checks are successfully passed, the control system energizes the Combustion Blower for pre-purge.
5. The control system must confirm the Blower Prover Switch contacts close after the Combustion Blower is energized.
6. If the Blower Prover Switch contacts are confirmed closed the control system energizes the Hot Surface Igniter for the igniter warm-up period.
7. The control system monitors the igniter current and must sense a minimum of 2.0 AC amps during the igniter warm up period (12-17 seconds).
8. If igniter amperage is confirmed at or above the required minimum the control system energizes the 24 Volt Gas Valve allowing gas to flow to the Main Burner.
9. The control system de-energizes the Hot Surface Igniter.
10. The control system monitors the flame sensor to confirm a flame is present at the Main Burner. If a flame is not verified during the ignition trial period the control system will try for ignition up to two more times. If flame can not be verified after three trials for ignition, the control system will lock out and display the “Ignition Failure” Fault message.
11. If a flame is verified, the control system will enter the heating mode where it will continue heating the water until the Operating Set Point is reached. At this point, the control system will de-energize the 24 Volt Gas Valve and enter the post-purge cycle (approximately 30 seconds).
12. The Combustion Blower will run for the duration of the post-purge cycle to purge the water heater of all combustion gases. When the post-purge cycle is complete, the blower is de-energized and will coast to a stop.
13. The control system now enters the standby mode while continuing to monitor the internal storage tank water temperature and the state of other system devices. If the tank temperature drops below the Operating Set Point minus the Differential setting, the control will automatically return to Step 2 and repeat the operating cycle.

SEQUENCE OF OPERATION FLOW CHART

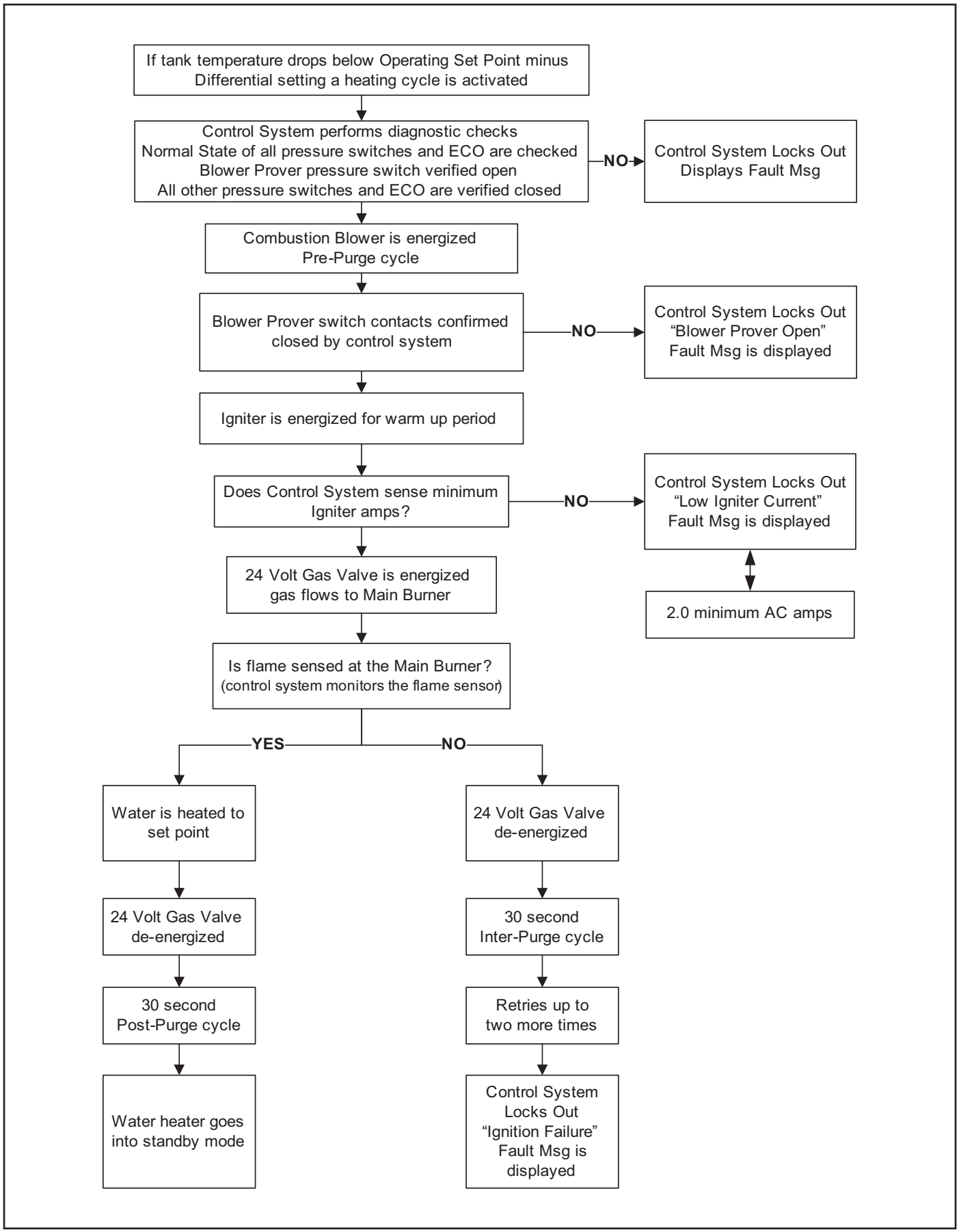

If tank temperature drops below Operating Set Point minus Differential setting a heating cycle is activated
Control System performs diagnostic checks
Normal State of all pressure switches and ECO are checked
Blower Prover pressure switch verified open
All other pressure switches and ECO are verified closed
NO
Control System Locks Out
Displays Fault Msg
Combustion Blower is energized
Pre-Purge cycle
Blower Prover switch contacts confirmed closed by control system
NO
Control System Locks Out
"Blower Prover Open"
Fault Msg is displayed
Igniter is energized for warm up period
Does Control System sense minimum Igniter amps?
NO
Control System Locks Out
"Low Igniter Current"
Fault Msg is displayed
2.0 minimum AC amps
24 Volt Gas Valve is energized
gas flows to Main Burner
Is flame sensed at the Main Burner?
(control system monitors the flame sensor)
YES
NO
Water is heated to set point
24 Volt Gas Valve de-energized
24 Volt Gas Valve de-energized
30 second Inter-Purge cycle
30 second Post-Purge cycle
Retries up to two more times
Water heater goes into standby mode
Control System Locks Out
"Ignition Failure"
Fault Msg is displayed

Figure 62

OPERATIONAL PROBLEMS

⚠WARNING

Read and understand this instruction manual and the safety messages herein before installing, operating or servicing this water heater.

Failure to follow these instructions and safety messages could result in death or serious injury.

This manual must remain with the water heater.

This section of the manual is intended to be an aid in correcting common operational problems, it is not all inclusive. The installer may be able to observe and correct certain problems which might arise when the water heater is first put into operation or when it is re-fired after a prolonged shutdown. However, only qualified service agents, as defined in Qualifications on page 6, using appropriate test equipment, should perform any service procedures on the water heater.

NOTE: Call the technical support phone number listed on the back cover of this manual for further technical assistance or to locate a qualified service agent in your area.

INSTALLATION ERRORS

Operational problems on new installations are often the result of installation requirements that have been overlooked rather than failed components. IE: A "Low Gas Pressure" Fault condition is most often caused by low supply gas pressure rather than a defective Low Gas Pressure switch. Rough starting and rough operation are often caused by undersized supply gas lines and/or the absence of a supply gas regulator at the water heater.

Prior to performing any operational checks inspect the water heater installation to ensure all installation requirements and instructions have been maintained and followed. See the Installation Checklist on page 58.

NOTE: Costs to correct installation errors are not covered under the limited warranty.

ROUGH STARTING, ROUGH OPERATION

⚠WARNING

Fire and Explosion Hazard

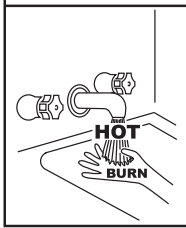
- Do not use water heater with any gas other than the gas shown on the rating label.
- Excessive gas pressure to gas valve can cause serious injury or death.
- Turn off gas lines during installation.
- Contact a qualified installer or service agency for installation and service.

- Undersized supply gas line (low volume of supply gas) - see Supply Gas Line on page 14.
- Supply gas regulator is not installed per installation requirements (erratic gas supply volume/pressures) - see Supply Gas Regulator on page 14.
- Excessive supply gas pressure - see Table 4 on page 14 and Supply Gas Pressure Adjustment on page 54.
- Excessive manifold gas pressure - see Table 4 on page 14 and Manifold Gas Pressure Adjustment on page 54.
- Vent (exhaust) gas recirculation at the vent and intake air pipe terminations on Direct Vent installations - see Direct Vent Installation on page 25.
- Excessive equivalent lengths of intake air and/or vent (exhaust) piping installed - see Venting Requirements on page 24.
- Debris clogging/blocking the intake air screen(s) - see Figure 19 on page 26 and Figure 26 on page 29.
- Debris clogging/blocking the Main Burner - see Figure 2 on page 7.

MOMENTARY IGNITION

⚠ CAUTION

Burn Hazard



- The combustion chamber and burner sleeve and housing become very hot during operation.
- Do not reach into the burner housing or combustion chamber if the water heater is still hot.
- Allow the water heater to cool and always use gloves when handling the main burner.

If the Main Burner ignites momentarily but does not sustain ignition allow the water heater to try to ignite up to two more times until control system locks out and the Ignition Failure Fault message is displayed on the control system's LCD. If the water heater is experiencing rough starts - see Rough Starting, Rough Operation on this page. For momentary ignition problems without rough starting check the following:

- Incorrect manifold gas pressure - see Table 4 on page 14 and Manifold Gas Pressure Adjustment on page 54.
- Undersized supply gas line (low volume of supply gas) - see Supply Gas Line on page 14.
- Supply gas regulator is not installed per installation requirements (erratic gas supply volume/pressures) - see Supply Gas Regulator on page 14.
- See the list of possible causes and things to check and repair for the Ignition Failure Fault message on page 62
- Debris clogging/blocking the intake air screen(s) - see Figure 19 on page 26 and Figure 26 on page 29.
- Debris clogging/blocking the Main Burner - see Figure 2 on page 7.

NOT ENOUGH OR NO HOT WATER

- No power to the water heater, check breaker, fuses and the water heater on/off switch.
- Hot water supply valve(s) to fixtures closed.
- Operating Set Point is set too low, Differential setting is set too high. See Control System Operation on page 44.
- Upper and/or Lower Probe Offset settings are causing the heating cycles to terminate prematurely - see Temperatures Menu (cont) on page 48.
- Ensure there is not any external supervisory control (using the enable/disable circuit) disabling heating operation. See Enable/Disable Circuit on page 41.
- The heating capacity of the water heater has been exceeded, the water heater is unable to meet demand.

- Colder incoming water temperature lengthening the time required to heat water to desired temperature.
- Hot water piping leaks, open faucets, water heater drain valve leaking or open.
- Sediment or lime scale accumulation may be affecting water heater operation. See Maintenance on page 64 for sediment and lime scale removal procedures.
- Water heater not firing at full input rating. Check manifold gas pressure, see instructions on page 54. Check actual firing rate of the water heater, see instructions on page 55.

WATER IS TOO HOT

- Operating Set Point is set too high. See Operating Set Point And Differential Adjustment on page 47.
- Upper and/or Lower Probe Offset settings improperly set - see Temperatures Menu (cont) on page 48.
- Improper water piping - see diagrams beginning on page 71.

NOISY OPERATION

- Sediment or lime scale accumulations can cause rumbling and pounding noises during heating cycles. See the Maintenance section of this manual beginning on page 64 for sediment and lime scale removal procedures.
- Normal operating noise of electrical components; Combustion Blower, transformer hum, relay contact closure.

WATER LEAKAGE IS SUSPECTED

- Ensure the water heater drain valve is tightly closed.
- Check cleanout opening for leaks - see Figure 5 on page 10.
- Check inlet/outlet water connections and system piping.
- Check the Temperature-Pressure Relief Valve.
  - Excessive water temperature.
  - Excessive water pressure.
  - Defective Temperature-Pressure Relief Valve.

NOTE: Excessive water pressure is the most common cause of Temperature-Pressure Relief Valve leakage. Excessive water system pressure is most often caused by "thermal expansion" in a "closed system." See Thermal Expansion and Closed Water Systems on page 15. The Temperature-Pressure Relief Valve is not intended for the constant relief of thermal expansion.

Temperature-Pressure Relief Valve leakage due to pressure build up in a closed system that does not have a thermal expansion tank installed is not covered under the limited warranty. Thermal expansion tanks must be installed on all closed water systems.

REPLACEMENT PARTS

Replacement parts may be ordered from the manufacturer, authorized service agencies or distributors. When ordering parts be sure to have the complete water heater Model Number, Serial Number and Series Number available. This information can be found on the rating label affixed to the water heater.

Refer to the parts list included with the water heater from the factory for more information or call the parts department or technical support phone number listed on the back cover of this manual for further assistance.

FAULT AND ALERT CONDITIONS

FAULT CONDITIONS

When the control system declares a Fault condition it will display a Fault message on the control system's LCD with an exclamation "!" mark. The control system will lock out and disable heating operation until the condition is corrected. The water heater must be serviced by a qualified service agent before operation can be restored.

ALERT CONDITIONS

When the control system declares an Alert condition it will display an Alert message on the control system's LCD with a question "?" mark. The water heater will continue to operate during an Alert condition but the water heater must be serviced by a qualified service agent as soon as possible.

RESETTING CONTROL SYSTEM LOCK OUTS

To reset the control system from a lock out condition; turn the power supply off for approximately 20 seconds and then back on. Keep in mind; if the condition that caused the Fault has not been corrected, the control system will continue to lock out.

DIAGNOSTIC CHECKS

⚠ WARNING

Electrical Shock Hazard

- Turn off power to the water heater before performing any service.
- Label all wires prior to disconnecting when performing service. Wiring errors can cause improper and dangerous operation.
- Verify proper operation after servicing.
- Failure to follow these instructions can result in personal injury or death.

The following section, Fault and Alert messages on page 62, lists some of the messages the control system will display on the LCD when there are operational problems. This is not a complete list. Along with each of the Fault and Alert messages described there will be a list of possible causes and things to check and repair.

Only qualified service agents, as defined in Qualifications on page 6, using appropriate test equipment, should perform any service procedures on the water heater.

NOTE: If you are not qualified and licensed or certified as required by the authority having jurisdiction to perform a given task do not attempt to perform any of the diagnostic or service procedures described in the following section.

If you do not understand the instructions in the following section do not attempt to perform any procedures.

Call the technical support phone number listed on the back cover of this manual for further technical assistance or to locate a qualified service agent in your area.

⚠ WARNING

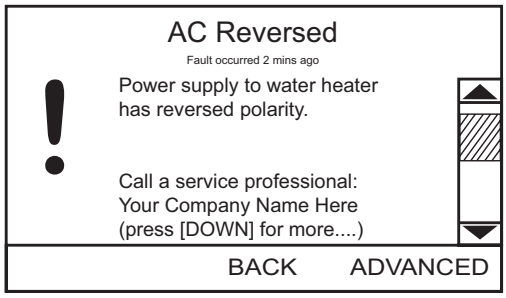
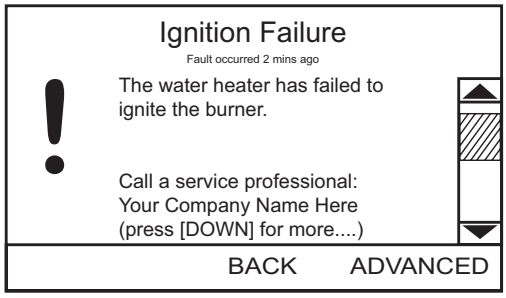
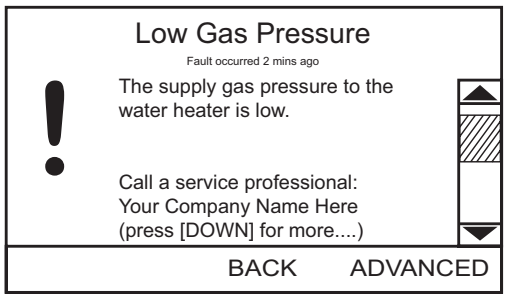
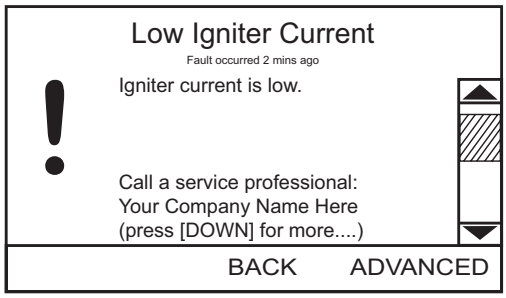
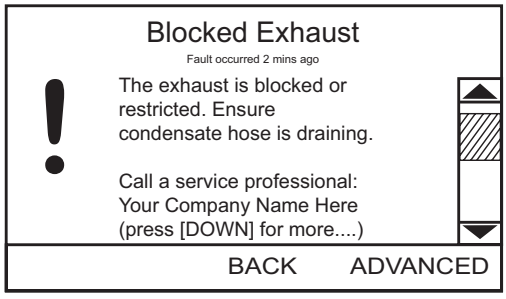
Jumping out control circuits or components can result in property damage, personal injury or death.

- Service should only be performed by a qualified service agent using proper test equipment.
- Altering the water heater controls and/or wiring in any way could result in permanent damage to the controls or water heater and is not covered under the limited warranty.
- Altering the water heater controls and/or wiring in any way could result in altering the ignition sequence allowing gas to flow to the main burner before the hot surface igniter is at ignition temperature causing delayed ignition which can cause a fire or explosion.

Any bypass or alteration of the water heater controls and/or wiring will result in voiding the appliance warranty.

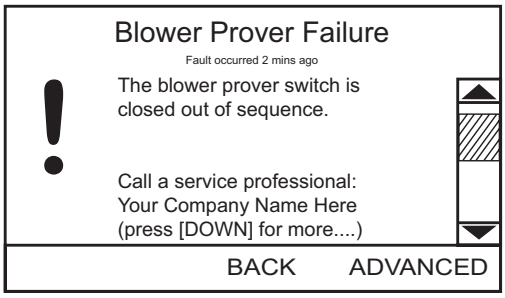
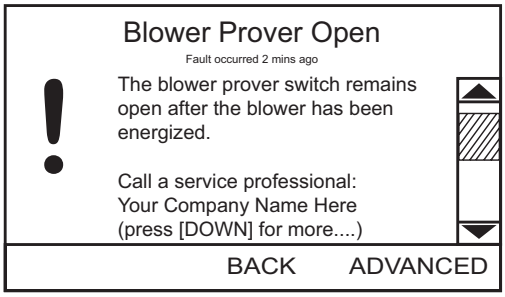
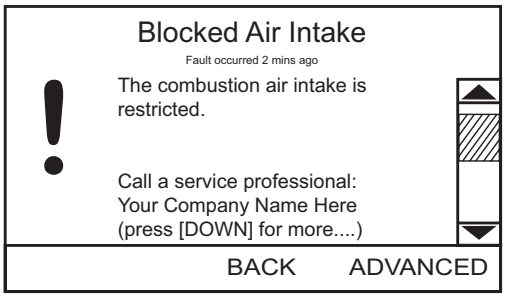
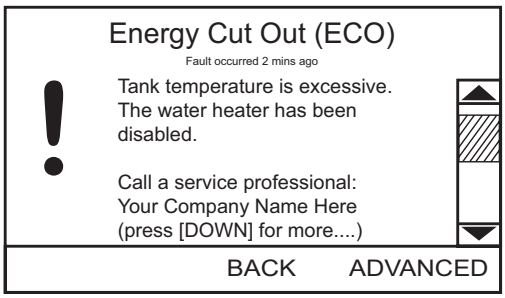
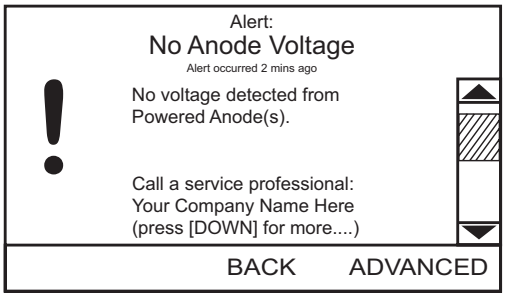
FAULT AND ALERT MESSAGES

Call the technical support phone number listed on the back cover for further technical assistance or to locate a qualified service agent in your area.

POSSIBLE CAUSES - CHECK/REPAIR	DISPLAYED FAULT/ALERT MESSAGE
• The water heater's control system is polarity sensitive and will lock out and disable heating operation if the polarity of the power supply is reversed. The control system will display the "AC Reversed" Fault message on the LCD in this condition. See Power Supply Connections on page 41 for instructions on how to properly connect the power supply. **NOTE:** Electronic flame sensing requires correct power supply polarity AND a proper earth ground to the water heater and the Main Burner. The control system does not verify earth ground but this should be checked first if ignition failure occurs. See the Ignition Failure Fault message information below.	
• The control system has failed to ignite the Main Burner. • Water heater is not properly grounded, loose or open ground wire to the Main Burner - see Power Supply Connections on page 41. • Dirty/corroded flame sensor, clean flame sensor with fine steel wool (replace if damaged) - see Figure 2 on page 7. • Loose or open wiring to the flame sensor. • Loose or open wiring to the 24 Volt Gas Valve. • 24 Volt Gas Valve on/off switch in the "off" position - see Figure 57 and Figure 58 on page 53. • Supply gas turned off, low gas volume - see page 39. • Intake air and/or vent piping is restricted or improperly installed - see Venting Installation on page 22. • Low or no manifold gas pressure to the Main Burner - see Initial Start Up on page 52.	
• The control system has detected the Low Gas Pressure Switch contacts are open. • Loose or open wiring to the Low Gas Pressure Switch - see beginning on page 8 for location. • Supply gas pressure is below the required minimum pressure - see Table 4 on page 14. • Supply gas is turned off at the Main Shutoff Valve. • Supply gas pressure is dropping when other gas fired appliances on a common supply gas line are operating. • Low volume of supply gas - see Supply Gas Line Installation on page 39 and the requirements for the Supply Gas Line on page 14 and Supply Gas Regulator on page 14.	
• The control system has detected low current (AC amps) from the Hot Surface Igniter. The control system monitors igniter current and will declare this Fault condition if the current is not at or above the programmed minimum requirement - see the Sequence of Operation beginning on page 58 for minimum igniter amp requirements. • Loose or open wiring to the Hot Surface Igniter - see Figure 2 on page 7 for igniter location. • Damaged, worn or open circuit Hot Surface Igniter. **NOTE:** Hot surface igniters are wearing parts. Wear is directly related to heating cycle count. Heating cycle count can be viewed in the Heater Information menu - see Heater Information on page 49. Increasing the Differential setting reduces heating cycle count - see Operating Set Point And Differential Adjustment on page 47.	
• The control system has detected the Blocked Exhaust Switch contacts are open. • The condensate drain is blocked filling the exhaust elbow with water - clear the condensate drain - see Figure 9 on page 17. • Loose or open wiring to the Blocked Exhaust Switch - see beginning on page 8 for switch location. • Restricted/blocked vent piping - condensate trapped in low point. • Excessive equivalent pipe length, exceeded the maximum number of 90° elbows or wrong pipe size used in the vent piping system - see Venting Requirements on page 24. • Excessive wind outdoors pressurizing the vent system piping. • Excessive negative air pressure in the installed space.	

FAULT AND ALERT MESSAGES (CONT)

Call the technical support phone number listed on the back cover for further technical assistance or to locate a qualified service agent in your area.

POSSIBLE CAUSES - CHECK/REPAIR	DISPLAYED FAULT/ALERT MESSAGE
• The control system has detected the Blower Prover Switch contacts are closed when they should be open at the beginning of a heating cycle - see the Sequence of Operation beginning on page 58. • Pinched/shorted Blower Prover Switch wiring - see beginning on page 8 for switch location. • Jumper wire connected to the Blower Prover Switch - remove jumper wire. Jumper wires must never be used, read all Warnings on page 61. • Excessive wind outdoors pressurizing the vent system piping. • Excessive negative air pressure in the installed space.	
• The control system has detected the Blower Prover Switch contacts are remaining open after the control system has energized the Combustion Blower - see the Sequence of Operation beginning on page 58. • Loose or open wiring to the Blower Prover Switch - see beginning on page 8 for switch location. • Blower Prover Switch air sensing tube disconnected, kinked, filed with condensate, damaged or leaking - repair or replace tube. • Combustion Blower is not running when energized. • Loose or open wiring or plug connections to Combustion Blower.	
• The control system has detected the Blocked Intake Air Switch contacts are open. • Loose or open wiring to the Blocked Intake Air Switch - see beginning on page 8 for switch location. • Excessive equivalent pipe length, exceeded the maximum number of 90° elbows or wrong pipe size used in the intake air piping system - see Venting Requirements on page 24. • Intake air screen was not removed prior to connecting the intake air piping to the water heater and is clogged/blocked with debris - see Figure 19 on page 26. • BTH 199 & 250 models only; condensate has drained into the Blocked Intake Air switch through the sensing tube, see BTH 199 & BTH 250 Intake Air Connection on page 23. • Excessive negative air pressure in the installed space.	
• The control system has detected the ECO (energy cut out) Switch contacts are open. • The ECO switch is a normally closed switch that opens on a temperature rise to prevent excessive water temperature in the storage tank. The ECO switch is inside the Upper Temperature Probe (two red wires) - see beginning on page 8 for Upper Probe location. • Loose or open wiring to the ECO switch in the Upper Temperature Probe - two red wires. • Improper water system piping and/or excessively high return (recirculation) loop water temperature - see the Water Piping Diagrams beginning on page 71.	
• The control system has not detected any voltage from the powered anode rods - see beginning on page 8 for location. • No water in the storage tank. • Loose or open wiring connections to the powered anode rods - see beginning on page 8 for location. • Powered anode rod wiring shorted to ground. • The water heater is not properly grounded - see Power Supply Connections on page 41. • Loose or open ground wires. • Top fitting (3/4 inch bushing) of the powered anode rods were saturated with water during installation - with power to the water heater turned off, carefully remove anode rods and dry out bushing(s).	

MAINTENANCE

GENERAL

Keep appliance area clear and free from combustible materials, gasoline and other flammable vapors and liquids. See Locating The Water Heater on page 12.

Water heater maintenance includes periodic tank flushing and cleaning, and removal of lime scale. The water heater should be inspected and adjusted to maintain proper combustion. See Initial Start Up on page 52. A periodic inspection of the venting system should be made. Where used, water circulating pump(s) should be oiled according to the pump manufacturers recommendations.

PRECAUTIONS

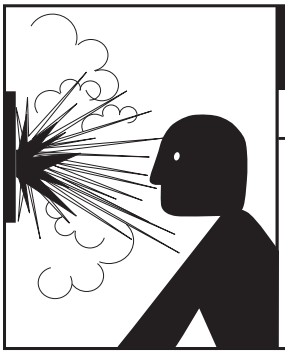
⚠ CAUTION

Do not operate the water heater if it has been exposed to or exhibits the following:

- Flooding at or above the level of the burner or controls.
- External damage.
- Firing without water.
- Sooting.

Do not operate the water heater until all corrective steps have been made by a qualified service agent.

Never operate the water heater without first being certain it is filled with water and a properly sized and rated Temperature-Pressure Relief Valve is installed in the relief valve opening on the water heater. See Temperature-Pressure Relief Valve on page 16.



⚠ WARNING

Explosion Hazard

- Overheated water can cause water tank explosion.
- Properly sized temperature and pressure relief valve must be installed in the opening provided.

Should overheating occur or the gas supply fail to shut off, turn of the Main Gas Shutoff valve. See Figure 52 on page 39.

Water heater maintenance includes periodic tank flushing and cleaning, and removal of lime scale. The water heater should be inspected and adjusted to maintain proper combustion. Refer to the following table. A periodic inspection of the venting system should be made. Where used, the water circulating pump should be oiled according to the pump manufacturer's recommendations.

MAINTENANCE SCHEDULE

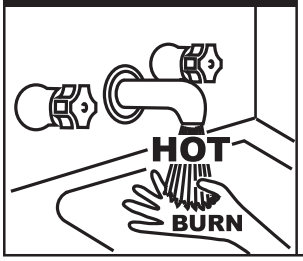
TABLE 14

COMPONENT	OPERATION	INTERVAL	REQUIRED
Tank	Sediment Removal	Semi Annually	Flushing
Tank	Lime Scale Removal	Semi Annually	UN-LIME®
Anode Rods	Inspection Cleaning	Annually	Clean Scale Deposits
T&P Valve	Test Operation	Semi Annually	Test
Vent System	Inspection	Annually	Termination Screens Clean Reseal/Repair

DRAINING AND FLUSHING

It is recommended that the water heater storage tank be drained and flushed every 6 months to reduce sediment buildup. The water heater should be drained if being shut down during freezing temperatures. See Features And Components on page 7 for the location of the water heater components described below.

⚠ DANGER



- Burn harzard.
- Hot water discharge.
- Keep hands clear of drain valve discharge.

To drain the water heater storage tank:

1. Turn off the electrical supply to the water heater.
2. Turn off the gas supply at the Main Gas Shutoff Valve if the water heater is going to be shut down for an extended period.
3. Ensure the cold water inlet valve is open.
4. Open a nearby hot water faucet and let the water run until the water is no longer hot.
5. Connect a hose to the water heater drain valve and terminate it to an adequate drain.
6. Close the cold water inlet valve.
7. Open the water heater drain valve and allow all the water to drain from the storage tank.
8. Close the water heater drain valve when all water in the storage tank has drained.
9. Close the hot water faucet opened in Step 4.
10. If the water heater is going to be shut down for an extended period, the drain valve should be left open.

To Flush the tank perform the following steps:

1. Turn off the electrical supply to the water heater.
2. Ensure the cold water inlet valve is open.
3. Open a nearby hot water faucet and let the water run until the water is no longer hot. Then close the hot water faucet.
4. Connect a hose to the drain valve and terminate it to an adequate drain.

5. Ensure the drain hose is secured before and during the entire flushing procedure. Flushing is performed with system water pressure applied to the water heater.
6. Open the water heater drain valve to flush the storage tank.
7. Flush the water heater storage tank to remove sediment and allow the water to flow until it runs clean.
8. Close the water heater drain valve when flushing is completed.
9. Remove the drain hose.
10. Fill the water heater - see Filling The Water Heater on page 52.
11. Turn on the electrical supply to place the water heater back in operation. See Initial Start Up on page 52.
12. Allow the water heater to complete several heating cycles to ensure it is operating properly.

FILLING THE WATER HEATER

See Filling The Water Heater on page 52.

SEDIMENT REMOVAL

Waterborne impurities consist of the particles of soil and sand which settle out and form a layer of sediment on the bottom of the tank.

For convenience, sediment removal and lime scale removal should be performed at the same time.

LIME SCALE REMOVAL

When water is heated dissolved minerals in the water such as calcium and magnesium carbonate (lime scale) become less soluble. As the water temperature rises these minerals will precipitate or “fall out” of solution.

The amount of lime scale released from water is in direct proportion to water temperature and usage. The higher the water temperature or water usage, the more lime deposits are dropped out of the water.

Water hardness also affects lime scale accumulation. With the temperature and usage being the same, hard water will release more lime scale than softer water.

Lime scale reduces heating efficiency as it accumulates inside a water heater. Heating transfer surfaces become coated with lime scale deposits which increases fuel costs to operate the water heater. Lime scale deposits can also cause rumbling and pounding noises as air molecules trapped in the lime scale escape when heated. Lime scale accumulation also reduces the life span of water heaters. For these reasons a regular schedule for deliming should be set up.

The depth of lime accumulation in the bottom of the water heater should be measured periodically. Inspect by removing the cleanout cover once every 6 months at first. Deliming maintenance should then be performed based on the time it takes for 1 inch (2.5 cm) of lime to accumulate in the bottom of the water heater.

Sediment and lime scale removal may be accomplished manually through the cleanout opening furnished on the water heater, see Figure 63.

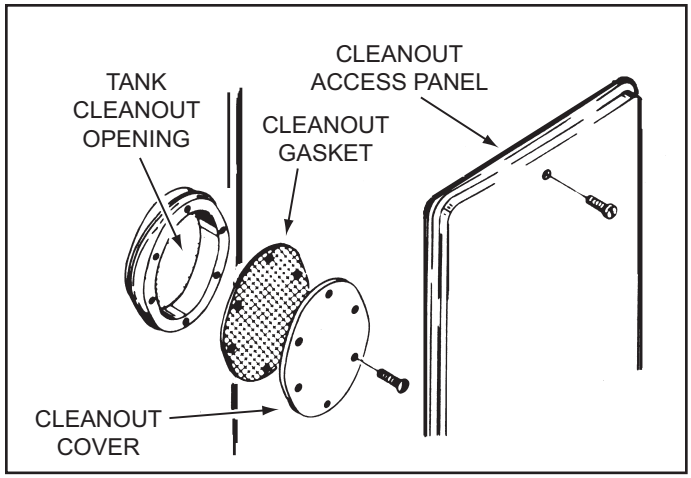


Figure 63

MANUAL LIME SCALE REMOVAL

NOTE: Contact your local distributor or call the parts department phone number on the back cover of this manual to order a new cleanout gasket. Have the new gasket available before removing the cleanout cover.

The cleanout opening is shown in Figure 63. To remove lime scale manually through the cleanout opening proceed as follows:

1. Turn off the electrical supply to the water heater.
2. The water heater must be drained, see Draining And Flushing on page 64, follow the instructions on how to drain the water heater.
3. Remove outer cleanout access plate from lower side of the water heater jacket.
4. Remove the cleanout cover from cleanout opening.
5. Remove lime, scale and/or sediment using care not to damage the glass-lining.
6. Install a new cleanout gasket if required.
7. Reinstall the cleanout cover. Be sure to draw plate up tight by tightening screws securely.
8. Close the water heater drain valve.
9. Fill the water heater - see Filling The Water Heater on page 52.
10. Turn on the electrical supply to place the water heater back in operation. See Initial Start Up on page 52.
11. Allow the water heater to complete several heating cycles to ensure it is operating properly.
12. Check for water leakage.
13. Reinstall the cleanout access plate.

CHEMICAL LIME SCALE REMOVAL

To dissolve and remove more stubborn lime scale deposits, UN-LIME® Professional Delimer should be used.

UN-LIME® Professional Delimer is an easy to handle patented food grade acid formulated specifically for lime scale removal from all types of water using equipment. Hydrochloric base acids must not be used to delime the water heaters covered in this manual.

Follow the instructions on the UN-LIME® to delime the water heater.

NOTE: Call the parts department phone number on the back cover of this manual to order UN-LIME® Professional Delimer. See TABLE 15 on page 66 for part numbers.

TABLE 15

UN-LIME® PROFESSIONAL DELIMER	
Part Number	**Description**
9005416105	4 - 1 gallon (case)
9005417105	1 - 5 gallon

POWERED ANODE RODS

To insure a long, trouble-free operating life, the water heaters covered in this manual are factory equipped with a powered anode system. The anode rods (2) are of a permanent design and do not need replacing unless damaged. Inspection and cleaning should be performed once a year.

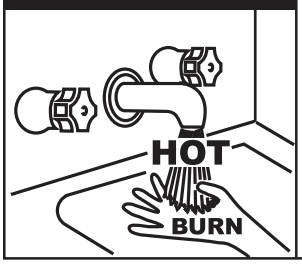
NOTE: Follow the instructions to drain the water heater storage tank on page 64 first. Remove the powered anodes from the water heater by loosening the 3/4" NPT bushing that forms the top of the anodes. Do not disassemble the retaining nut and wire terminal from the top while installed in the water heater, the anode's electrode may fall inside the tank. Remove the entire anode rod from the water heater prior to inspection. Clean the anode rods with a soft cloth and reinstall. Follow the instructions for filling the water heater on page 52 when finished.

DRAIN VALVE AND ACCESS PANELS

The water heaters covered in this manual are equipped with a drain valve, see Features And Components on page 7 for location. The water heaters covered in this manual are also equipped with a cleanout opening for sediment and lime scale removal. See Figure 63 on page 65.

TEMPERATURE-PRESSURE RELIEF VALVE TEST

⚠DANGER



- Burn hazard.
- Hot water discharge.
- Keep clear of Temperature-Pressure Relief Valve discharge outlet.

It is recommended that the Temperature-Pressure Relief Valve should be checked to ensure that it is in operating condition every 6 months.

When checking the Temperature-Pressure Relief Valve operation, make sure that (1) no one is in front of or around the outlet of the Temperature-Pressure Relief Valve discharge line, and (2) that the water discharge will not cause any property damage, as the water may be extremely hot. Use care when operating valve as the valve may be hot.

To check the relief valve, lift the lever at the end of the valve several times, see Figure 64. The valve should seat properly and operate freely.

If after manually operating the valve, it fails to completely reset and continues to release water, immediately close the cold water inlet to the water heater and drain the water heater, see Draining And Flushing on page 64. Replace the Temperature-Pressure Relief Valve with a properly rated/sized new one, see Temperature-Pressure Relief Valve on page 16 for instructions on replacement.

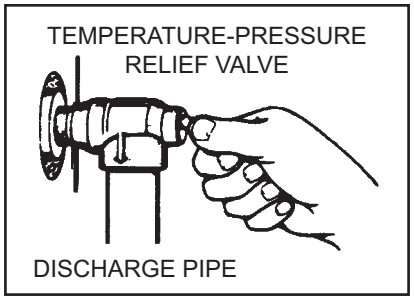


Figure 64

If the Temperature-Pressure Relief Valve on the water heater weeps or discharges periodically, this may be due to thermal expansion.

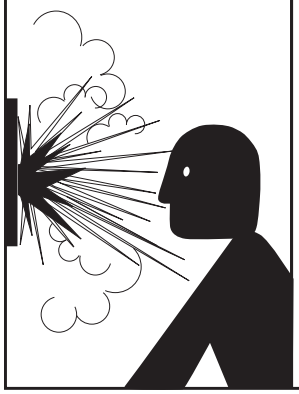
NOTE: Excessive water pressure is the most common cause of Temperature-Pressure Relief Valve leakage. Excessive water system pressure is most often caused by "thermal expansion" in a "closed system." See Thermal Expansion and Closed Water Systems on page 15. The Temperature-Pressure Relief Valve is not intended for the constant relief of thermal expansion.

Temperature-Pressure Relief Valve leakage due to pressure build up in a closed system that does not have a thermal expansion tank installed is not covered under the limited warranty. Thermal expansion tanks must be installed on all closed water systems.

DO NOT PLUG THE TEMPERATURE-PRESSURE RELIEF VALVE OPENING. THIS CAN CAUSE PROPERTY DAMAGE, SERIOUS INJURY OR DEATH.

⚠WARNING

Explosion Hazard



- Temperature-Pressure Relief Valve must comply with ANSI Z21.22-CSA 4.4 and ASME code.
- Properly sized temperature-pressure relief valve must be installed in opening provided.
- Can result in overheating and excessive tank pressure.
- Can cause serious injury or death.

VENT SYSTEM

Examine the vent system once a year. Points of inspection are as follows:

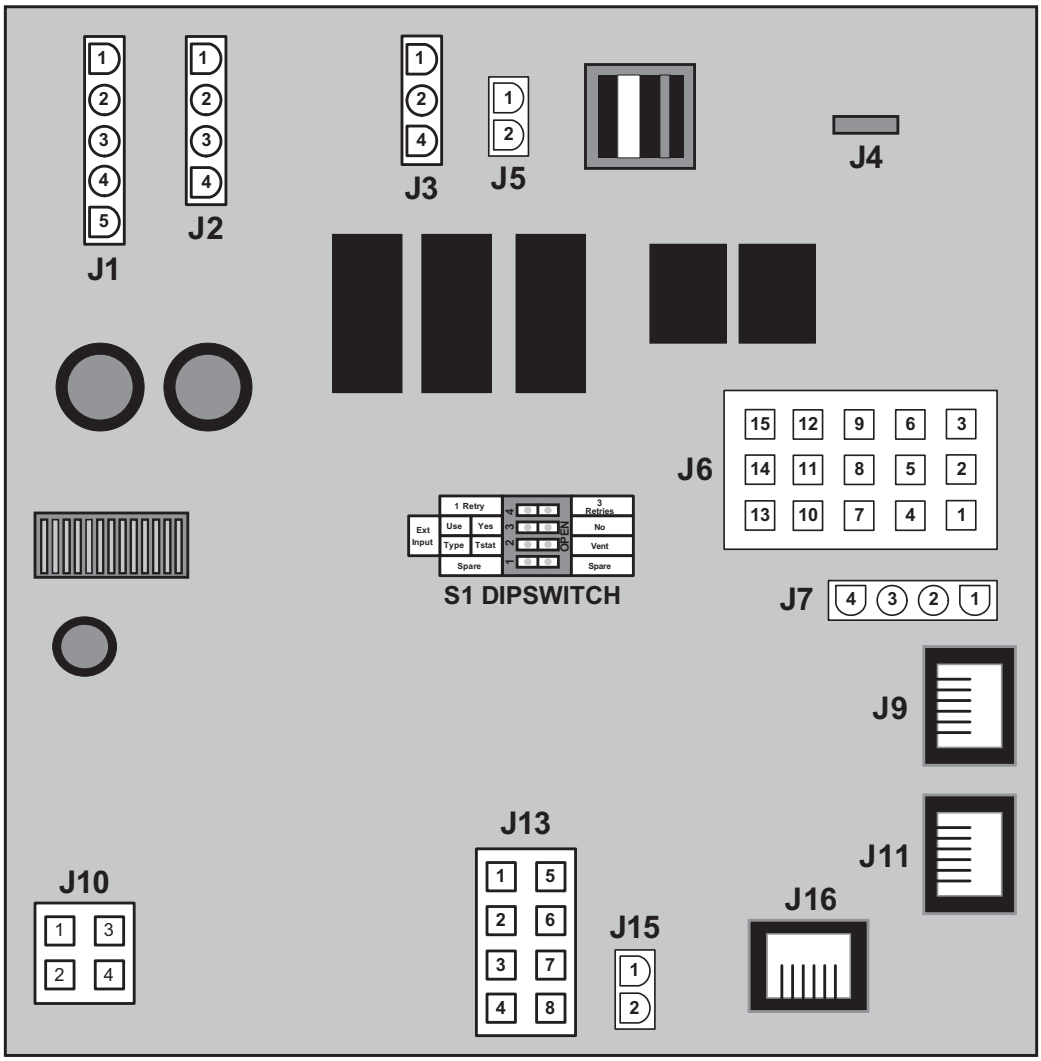
1. Check for obstructions and/or deterioration of the intake air and/or vent piping and the intake air and vent terminations. Replace immediately where needed.
2. The debris screens in the intake air and vent terminations should be should be cleaned of foreign material and soot. See Figure 26 on page 29.

   NOTE: Do not reach inside the vent hood when the heater is in operation.
3. Check all vent system connections for leakage and repair or reseal as necessary.

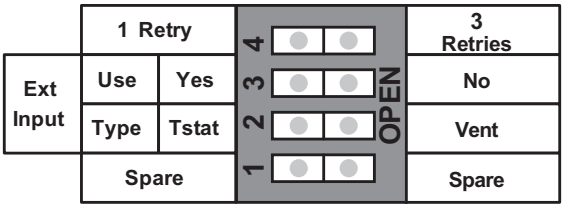
DIAGRAMS

CCB - CENTRAL CONTROL BOARD LAYOUT

CCB (CENTRAL CONTROL BOARD)



S1 DIPSWITCH DETAIL



Dipswitch Operation:
Along one side of the dipswitch array there are numbers, 1-4. On the other side of the dipswitch is the word “OPEN.” The dipswitches are rocker type switches, if one side of the rocker is down the other side will be up. Pressing a rocker down on the side of the array labeled “OPEN,” opens the switch. Pressing a rocker down on the side of the array labeled with the numbers 1-4 closes the dipswitch.

CHANGING NUMBER OF IGNITION TRIALS BEFORE LOCK OUT

NOTE: Always turn off power to the water heater before changing dipswitch settings.

Set dipswitch #4 to the open position for 1 trial for ignition before Ignition Failure lock out. Set dipswitch #4 to the closed position for 3 trials for ignition before Ignition Failure lock out.

Figure 65

BTH 120 & 150 WIRING DIAGRAM

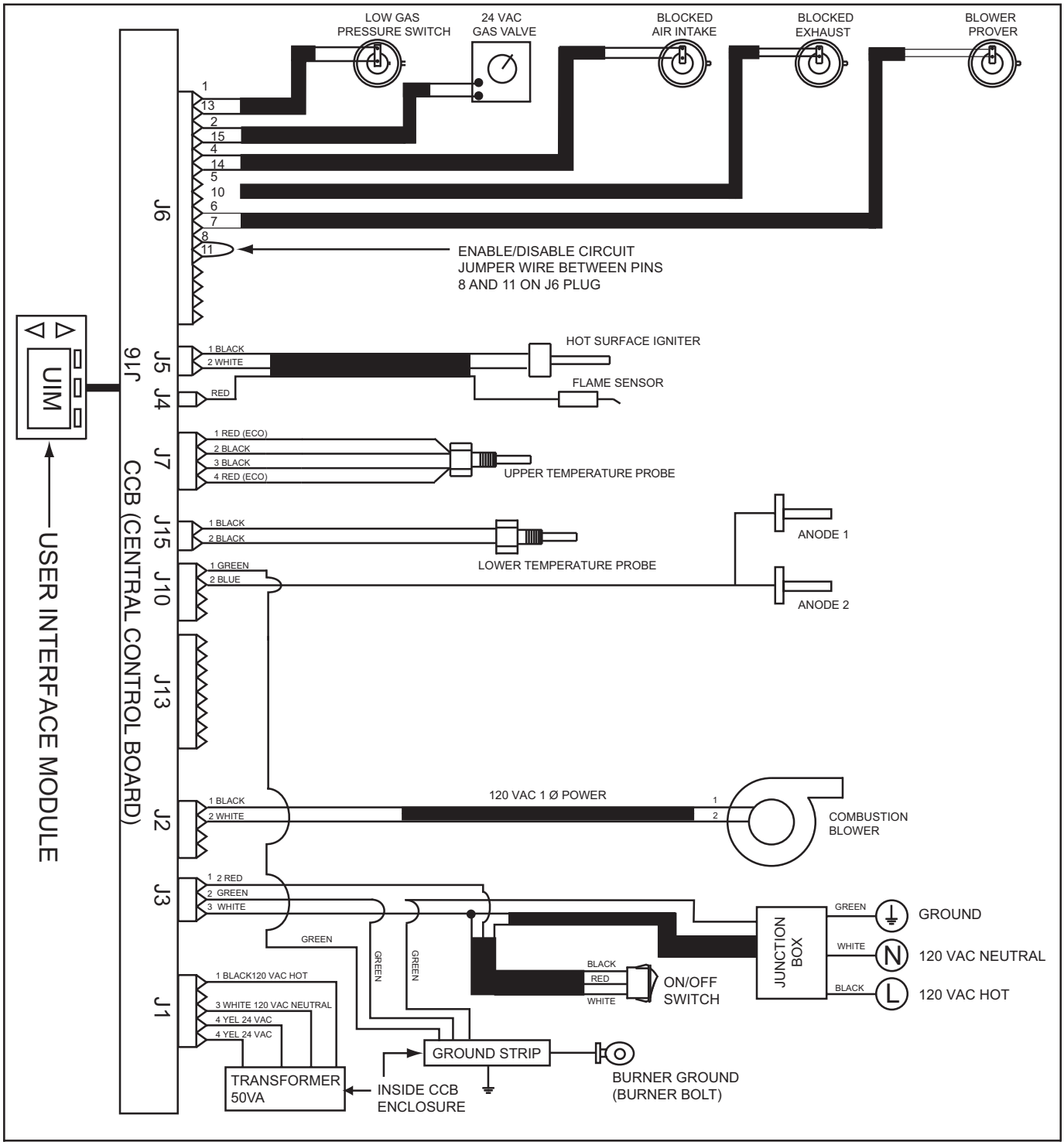


Figure 66

BTH 199 & 250 WIRING DIAGRAM

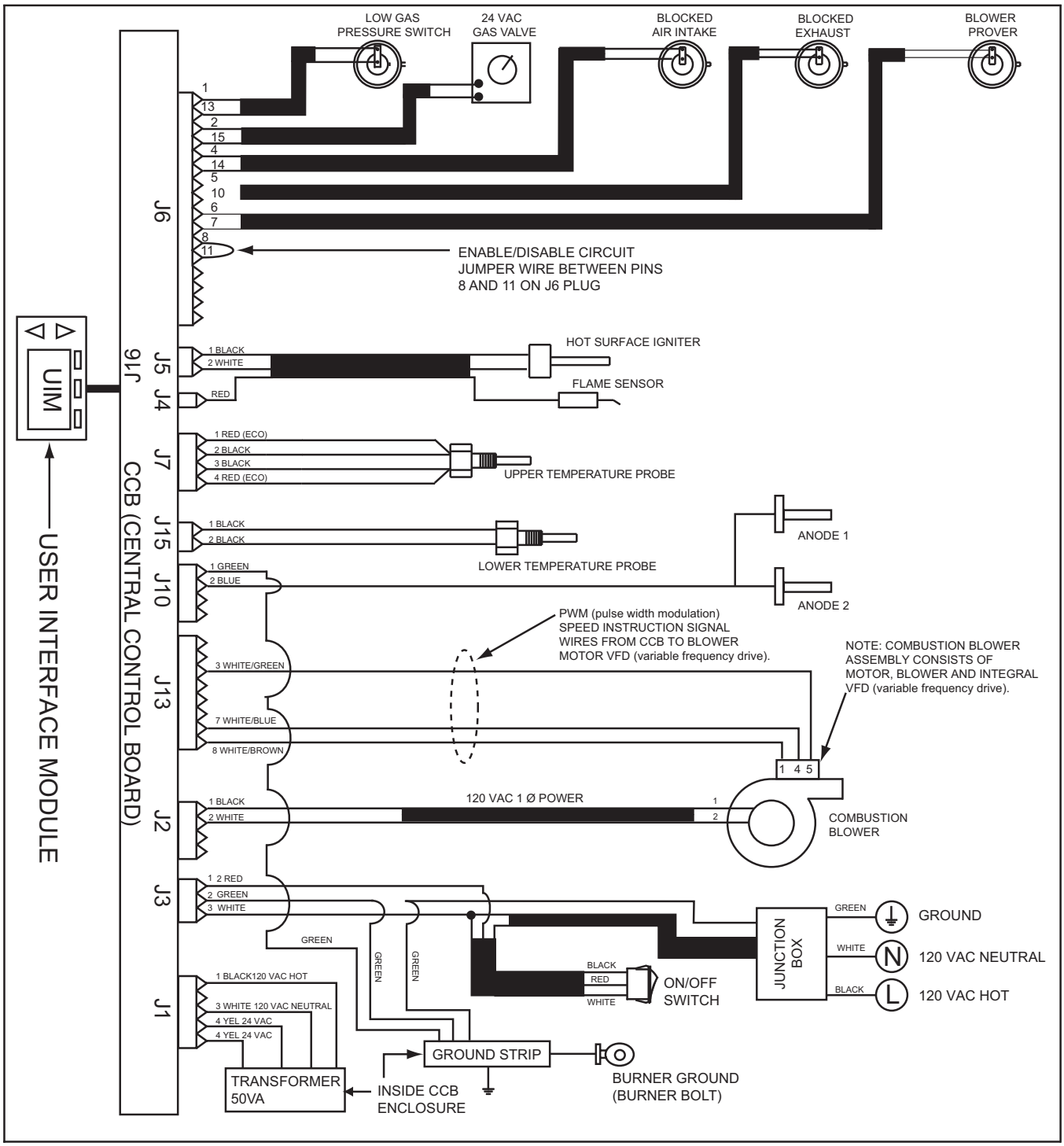


Figure 67

CIRCULATION PUMP WIRING DIAGRAMS

CIRCULATING PUMP WIRING DIAGRAM
STORAGE TANK OR BUILDING RECIRCULATION

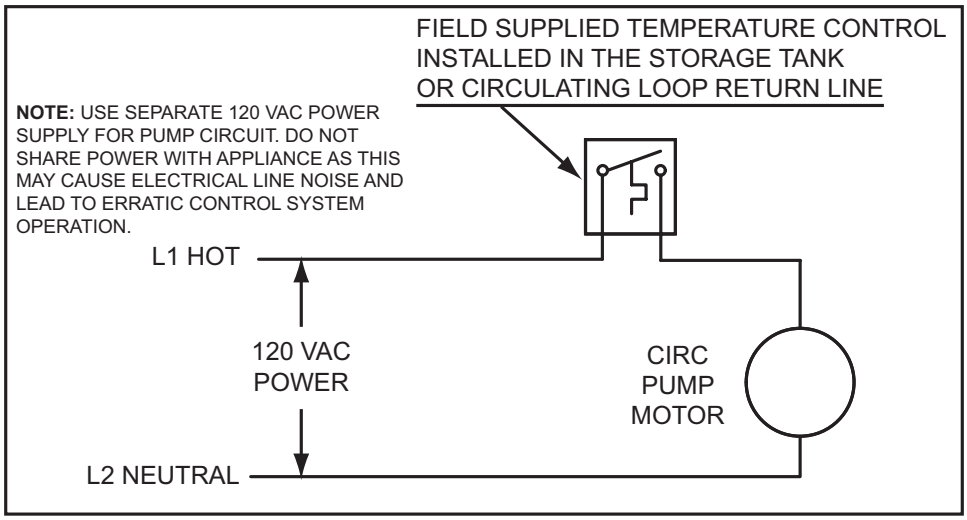

FIELD SUPPLIED TEMPERATURE CONTROL
INSTALLED IN THE STORAGE TANK
OR CIRCULATING LOOP RETURN LINE
NOTE: USE SEPARATE 120 VAC POWER SUPPLY FOR PUMP CIRCUIT. DO NOT SHARE POWER WITH APPLIANCE AS THIS MAY CAUSE ELECTRICAL LINE NOISE AND LEAD TO ERRATIC CONTROL SYSTEM OPERATION.
L1 HOT
120 VAC
POWER
L2 NEUTRAL
CIRC
PUMP
MOTOR

Figure 68

CIRCULATING PUMP WIRING DIAGRAM
DISHWASHER LOOP WITH TOGGLE SWITCH

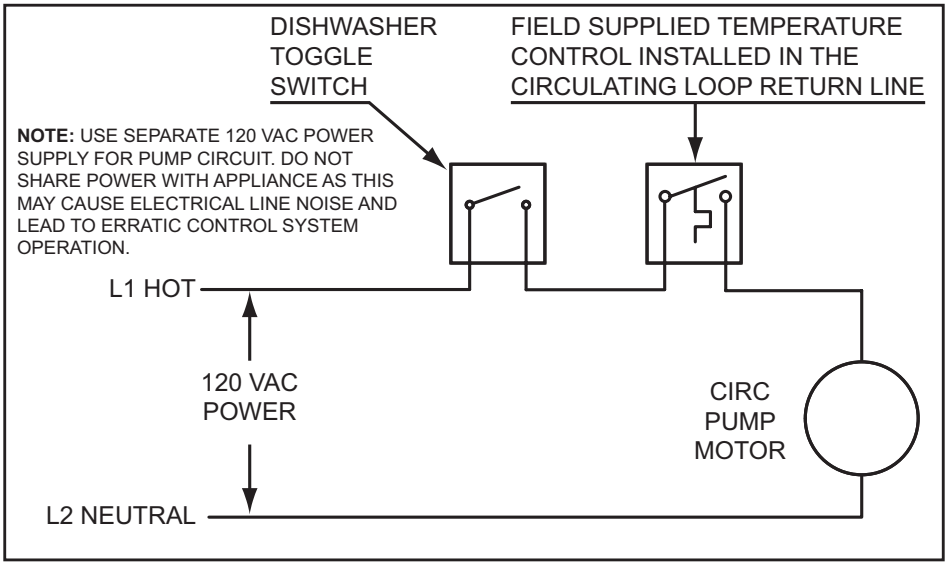


Figure 69

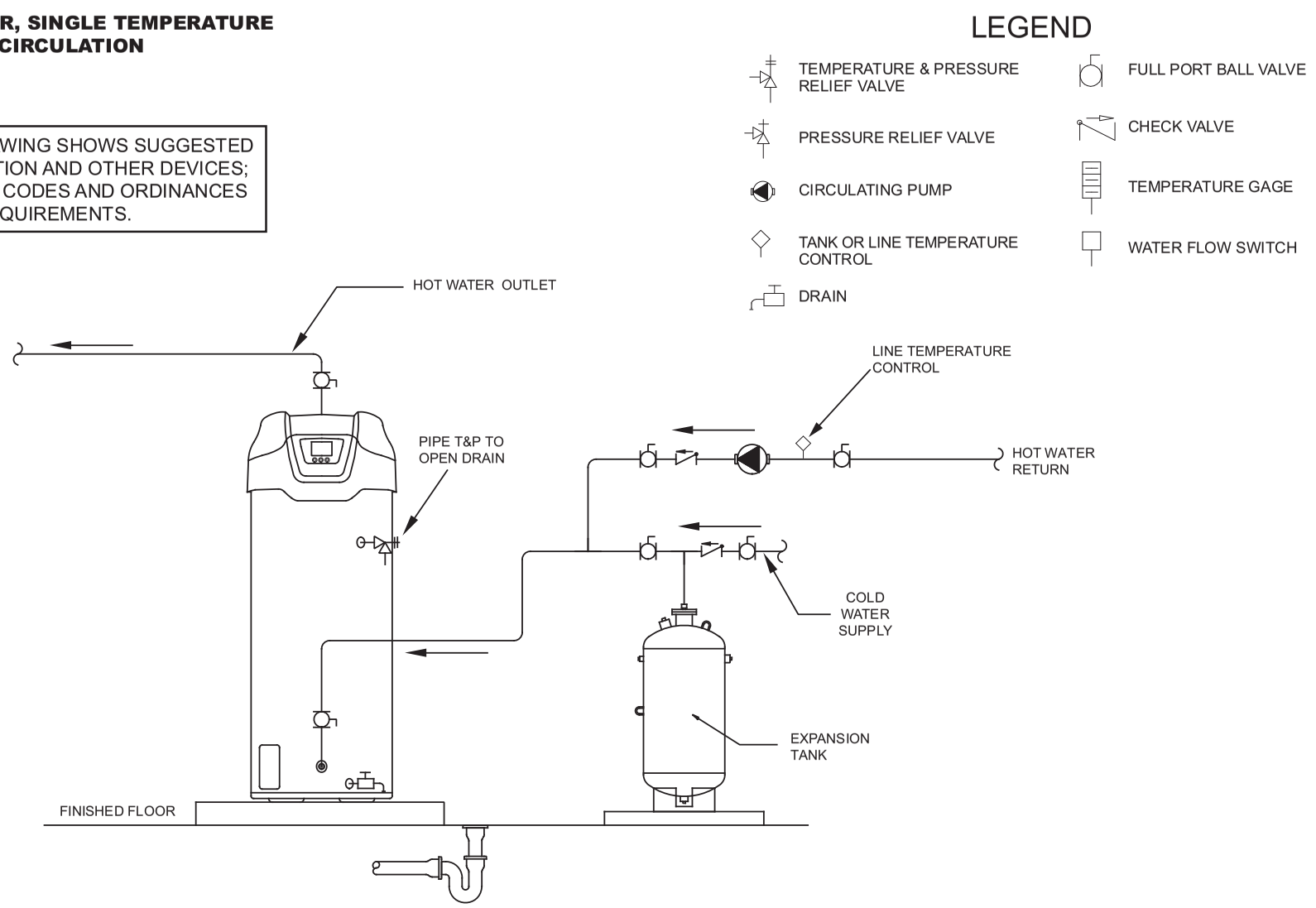
WATER PIPING DIAGRAMS

Before installation of water piping review the following:

1. See Mixing Valves on page 15.
2. See Dishwashing Machines on page 15.
3. See Temperature-Pressure Relief Valve on page 16.
4. See Closed Systems and Thermal Expansion on page 15
5. See Water Line Connections on page 42.
6. If a pump is being installed between a water heater and storage tank or on a building recirculation loop wire according to Figure 68 on page 70.
7. If a pump is being installed in a recirculation loop between the water heater and a commercial dishwasher wire according to Figure 68 or Figure 69 on page 70.

ONE WATER HEATER, SINGLE TEMPERATURE WITH BUILDING RECIRCULATION

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.



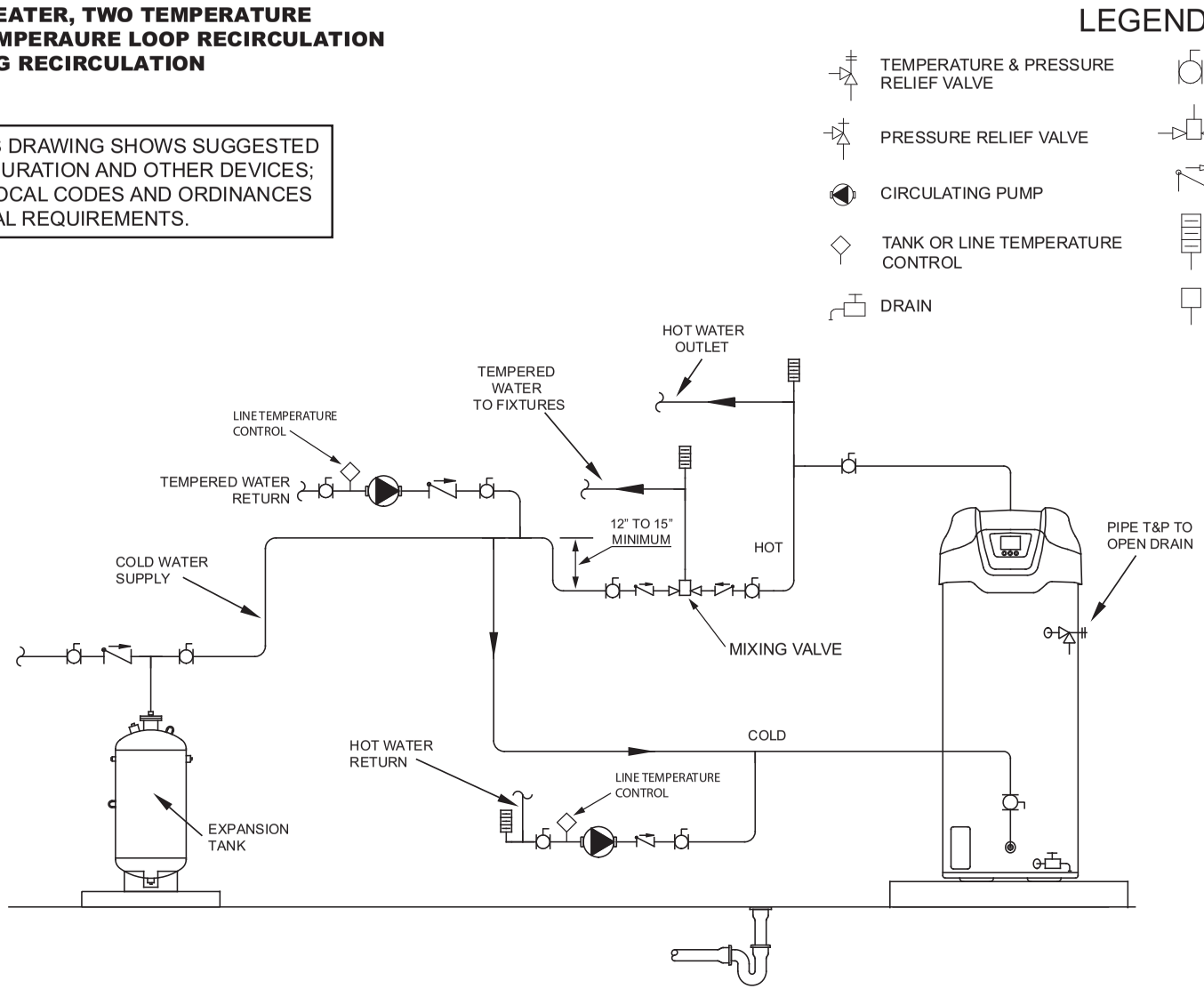
WATER PIPING DIAGRAMS

Before installation of water piping review the following:

1. See Mixing Valves on page 15.
2. See Dishwashing Machines on page 15.
3. See Temperature-Pressure Relief Valve on page 16.
4. See Closed Systems and Thermal Expansion on page 15
5. See Water Line Connections on page 42.
6. If a pump is being installed between a water heater and storage tank or on a building recirculation loop wire according to Figure 68 on page 70.
7. If a pump is being installed in a recirculation loop between the water heater and a commercial dishwasher wire according to Figure 68 or Figure 69 on page 70.

ONE WATER HEATER, TWO TEMPERATURE WITH HIGH TEMPERAURE LOOP RECIRCULATION WITH BUILDING RECIRCULATION

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.



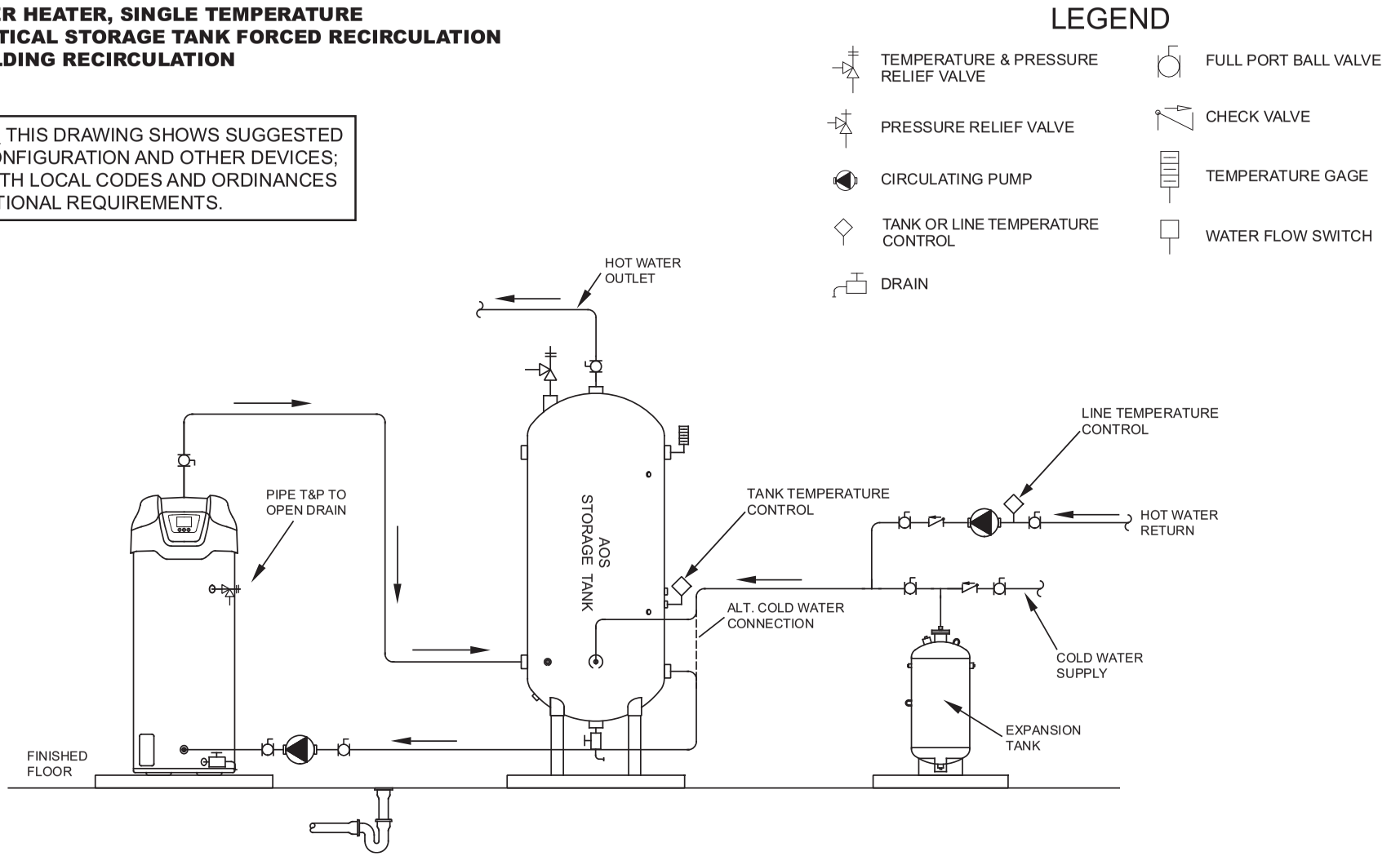
WATER PIPING DIAGRAMS

Before installation of water piping review the following:

1. See Mixing Valves on page 15.
2. See Dishwashing Machines on page 15.
3. See Temperature-Pressure Relief Valve on page 16.
4. See Closed Systems and Thermal Expansion on page 15
5. See Water Line Connections on page 42.
6. If a pump is being installed between a water heater and storage tank or on a building recirculation loop wire according to Figure 68 on page 70.
7. If a pump is being installed in a recirculation loop between the water heater and a commercial dishwasher wire according to Figure 68 or Figure 69 on page 70.

ONE WATER HEATER, SINGLE TEMPERATURE WITH VERTICAL STORAGE TANK FORCED RECIRCULATION WITH BUILDING RECIRCULATION

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.



NOTE:
The water heater's Operating Set Point should be set 5° higher than the Tank Temperature Control in the auxiliary storage tank.

WATER PIPING DIAGRAMS

Before installation of water piping review the following:

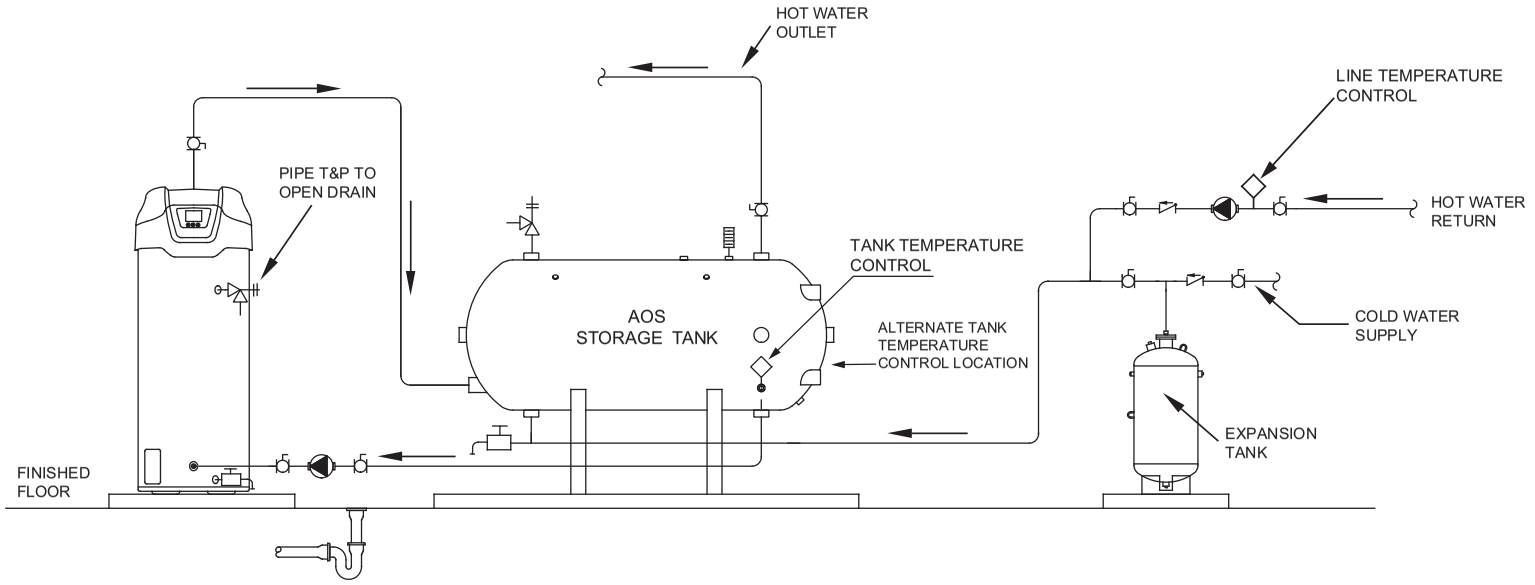
1. See Mixing Valves on page 15.
2. See Dishwashing Machines on page 15.
3. See Temperature-Pressure Relief Valve on page 16.
4. See Closed Systems and Thermal Expansion on page 15
5. See Water Line Connections on page 42.
6. If a pump is being installed between a water heater and storage tank or on a building recirculation loop wire according to Figure 68 on page 70.
7. If a pump is being installed in a recirculation loop between the water heater and a commercial dishwasher wire according to Figure 68 or Figure 69 on page 70.

ONE WATER HEATER, SINGLE TEMPERATURE
WITH HORIZONTAL STORAGE TANK FORCED RECIRCULATION
WITH BUILDING RECIRCULATION

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

LEGEND

- TEMPERATURE & PRESSURE RELIEF VALVE
- PRESSURE RELIEF VALVE
- CIRCULATING PUMP
- TANK OR LINE TEMPERATURE CONTROL
- DRAIN
- FULL PORT BALL VALVE
- MIXING VALVE
- CHECK VALVE
- TEMPERATURE GAGE
- WATER FLOW SWITCH



NOTE:
The water heater's Operating Set Point should be set 5° higher than the Tank Temperature Control in the auxiliary storage tank.

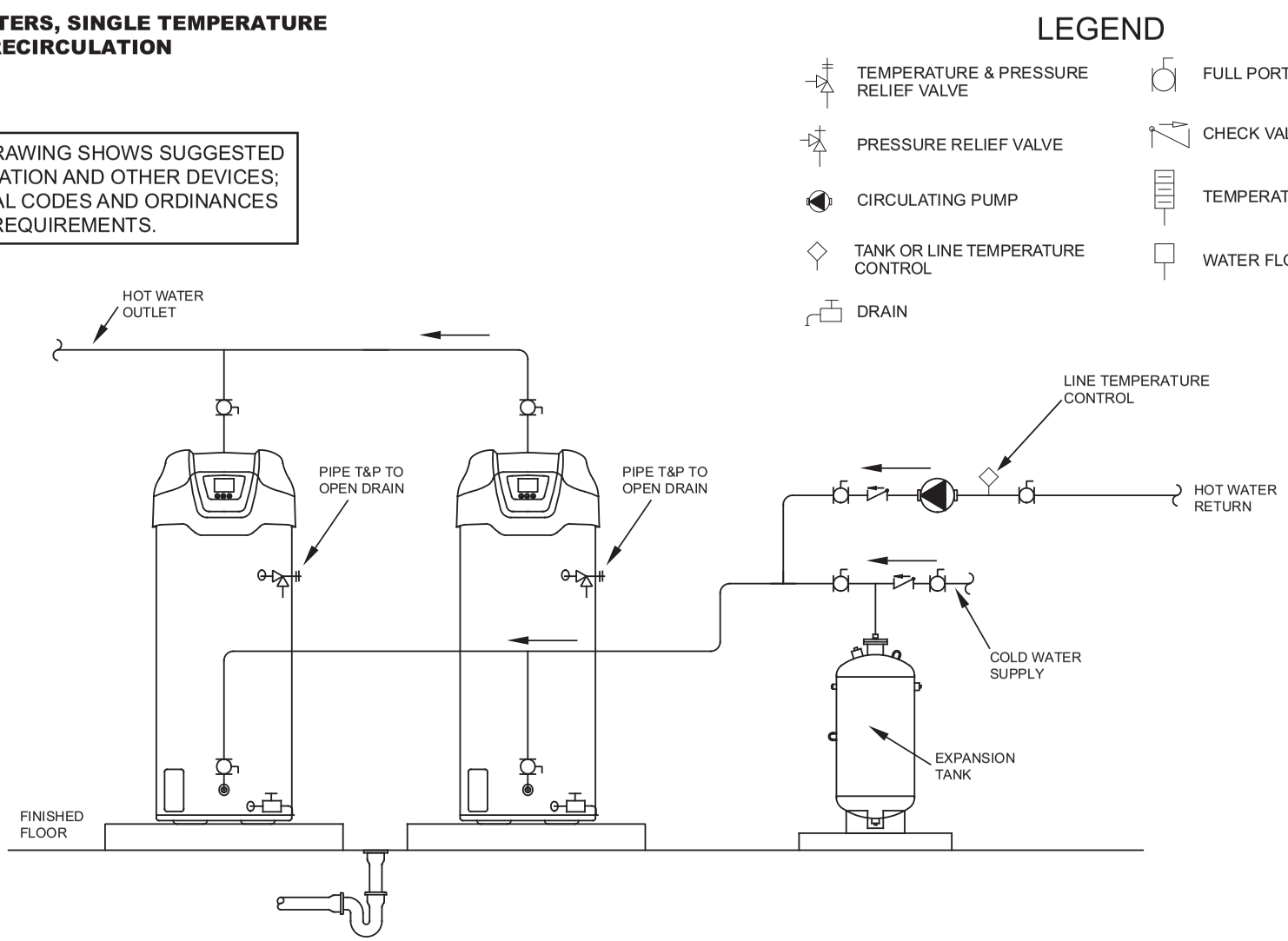
WATER PIPING DIAGRAMS

Before installation of water piping review the following:

1. See Mixing Valves on page 15.
2. See Dishwashing Machines on page 15.
3. See Temperature-Pressure Relief Valve on page 16.
4. See Closed Systems and Thermal Expansion on page 15
5. See Water Line Connections on page 42.
6. If a pump is being installed between a water heater and storage tank or on a building recirculation loop wire according to Figure 68 on page 70.
7. If a pump is being installed in a recirculation loop between the water heater and a commercial dishwasher wire according to Figure 68 or Figure 69 on page 70.

TWO WATER HEATERS, SINGLE TEMPERATURE WITH BUILDING RECIRCULATION

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.



WATER PIPING DIAGRAMS

Before installation of water piping review the following:

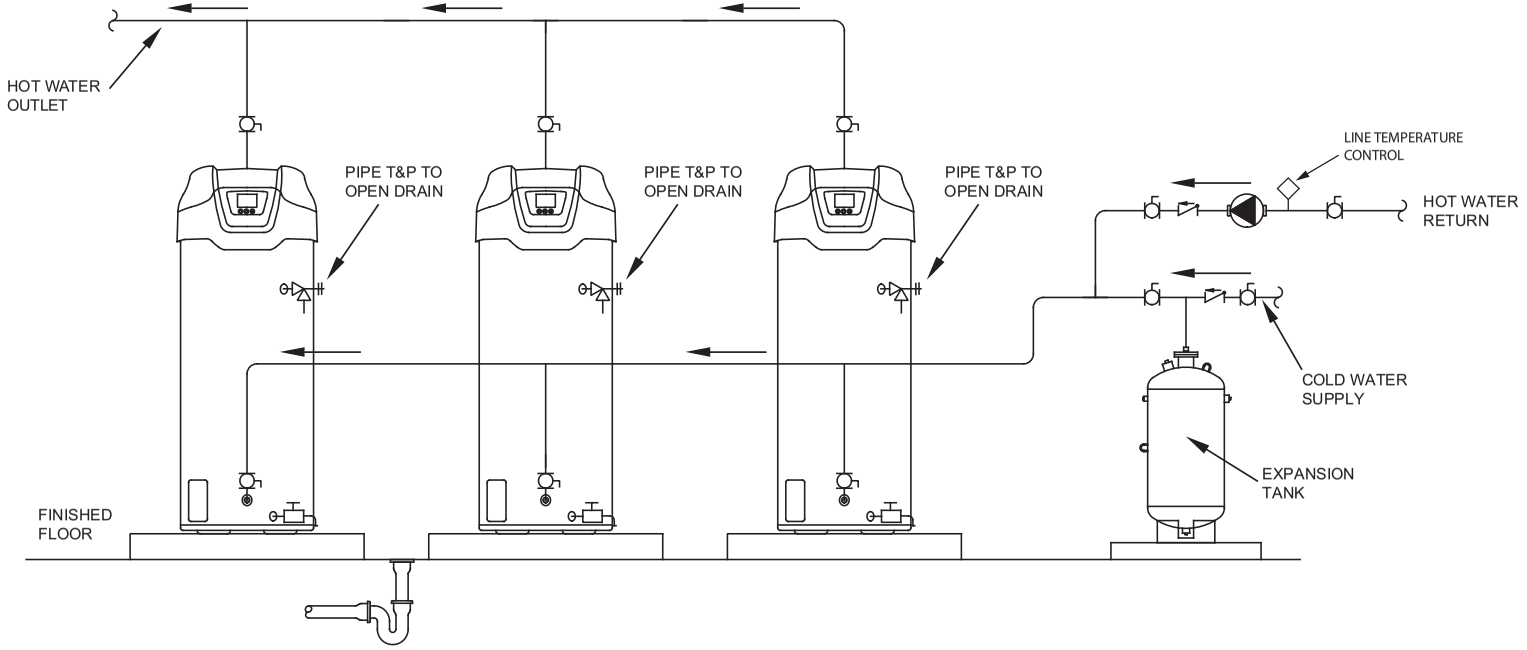
1. See Mixing Valves on page 15.
2. See Dishwashing Machines on page 15.
3. See Temperature-Pressure Relief Valve on page 16.
4. See Closed Systems and Thermal Expansion on page 15
5. See Water Line Connections on page 42.
6. If a pump is being installed between a water heater and storage tank or on a building recirculation loop wire according to Figure 68 on page 70.
7. If a pump is being installed in a recirculation loop between the water heater and a commercial dishwasher wire according to Figure 68 or Figure 69 on page 70.

THREE WATER HEATERS, SINGLE TEMPERATURE WITH BUILDING RECIRCULATION

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

LEGEND

- TEMPERATURE & PRESSURE RELIEF VALVE
- PRESSURE RELIEF VALVE
- CIRCULATING PUMP
- TANK OR LINE TEMPERATURE CONTROL
- DRAIN
- FULL PORT BALL VALVE
- CHECK VALVE
- TEMPERATURE GAGE
- WATER FLOW SWITCH



WATER PIPING DIAGRAMS

Before installation of water piping review the following:

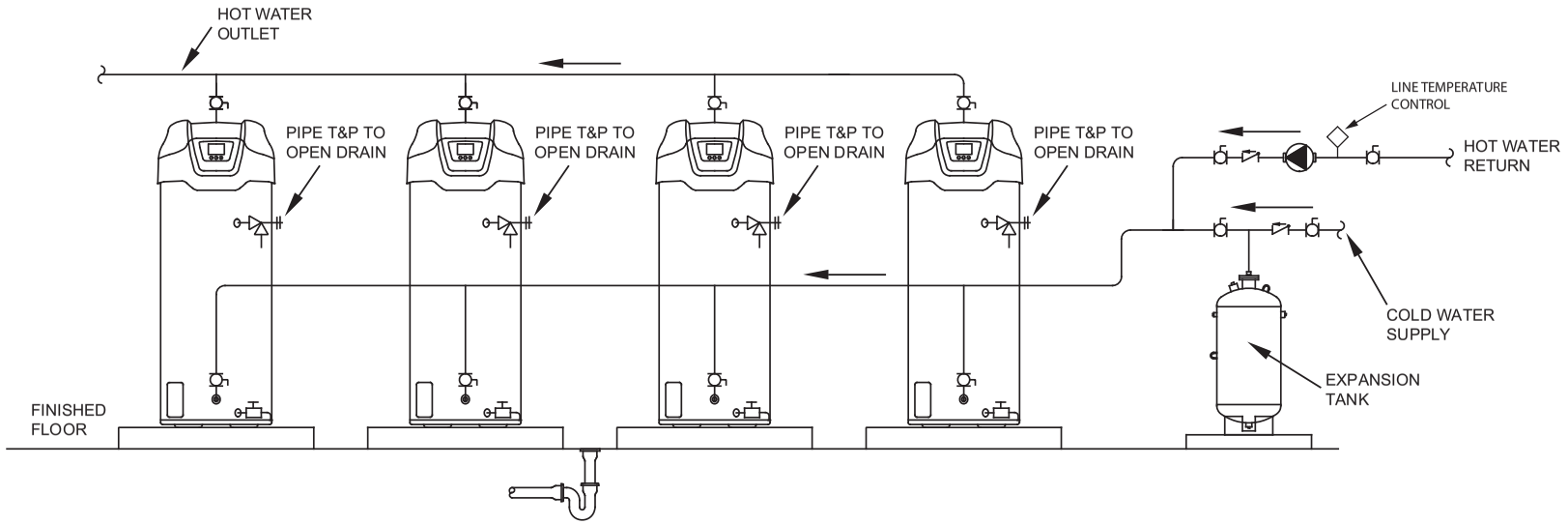
1. See Mixing Valves on page 15.
2. See Dishwashing Machines on page 15.
3. See Temperature-Pressure Relief Valve on page 16.
4. See Closed Systems and Thermal Expansion on page 15
5. See Water Line Connections on page 42.
6. If a pump is being installed between a water heater and storage tank or on a building recirculation loop wire according to Figure 68 on page 70.
7. If a pump is being installed in a recirculation loop between the water heater and a commercial dishwasher wire according to Figure 68 or Figure 69 on page 70.

FOUR WATER HEATERS, SINGLE TEMPERATURE WITH BUILDING RECIRCULATION

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

LEGEND

- TEMPERATURE & PRESSURE RELIEF VALVE
- PRESSURE RELIEF VALVE
- CIRCULATING PUMP
- TANK OR LINE TEMPERATURE CONTROL
- DRAIN
- FULL PORT BALL VALVE
- CHECK VALVE
- TEMPERATURE GAGE
- WATER FLOW SWITCH



LIMITED WARRANTY

A. O. Smith Corporation, the warrantor, extends the following LIMITED WARRANTY to the owner of this water heater.

1. THE TANK

If the glass-lined tank in this water heater shall prove upon examination by the warrantor to have leaked due to natural corrosion from potable water therein, during the first THREE years after initial installation, the warrantor will supply a replacement tank less burner and controls or a complete new A. O. Smith water heater of equivalent size and current model at the warrantor's option. Some government agencies are requiring energy efficient standards for water heaters. In the event regulations prohibit sale of a model of equivalent size and construction, A. O. Smith will provide a model which complies with the regulations of your area, in which case the consumer will be charged the difference in price between the like replacement and the energy efficient model required. The warranty on the replacement water heater will be limited to the unexpired term of the original warranty.

2. ALL OTHER PARTS

If within ONE year after initial installation of this water heater, any part or portion shall prove upon examination by the warrantor to be defective in material or workmanship, the warrantor will repair or replace such part or portion at its option.

3. CONDITIONS AND EXCEPTIONS

This warranty shall apply only when the water heater is installed in accordance with local plumbing and building codes, ordinances and regulations, the printed instructions provided with it and good industry practices. In addition, a temperature and pressure relief valve, certified by CSA and approved by the American Society of Mechanical Engineers, must have been installed.

a. This warranty shall apply only when the water heater is:
   (1) owned by the original purchaser;
   (2) used at temperatures not exceeding the maximum setting of its thermostat;
   (3) used at water pressure not exceeding the working pressure shown on the heater;
   (4) used when operated free of the damaging effects of uncontrolled water hammer;
   (5) used when filled with potable water, free to circulate at all times;
   (6) used in a non-corrosive and non-contaminated atmosphere;
   (7) used with factory approved anode(s) installed;
   (8) in its original installation location;
   (9) in the United States, its territories or possessions, and Canada;
   (10) sized in accordance with proper sizing techniques for commercial water heaters;
   (11) bearing a rating plate which has not been altered, defaced or removed except as required by the warrantor;
   (12) fired at the factory rated input using the fuel stated on the rating plate;
   (13) maintained in accordance with the instructions printed in the manual included with the water heater.

b. Any accident to the water heater, any misuse, abuse (including freezing) or alteration of it, any operation of it in a modified form, or any attempt to repair tank leaks will void this warranty.

c. This warranty is void if a device acting as a backflow prevention device (check valves etc.) is installed in the cold water supply the heater is connected to, unless an effective method of controlling thermal expansion is also installed at the heater(s) and operational at all times.
   The temperature and pressure relief valve installed on the heater is not an acceptable method.

4. SERVICE AND REPAIR EXPENSES

Under the limited warranty the warrantor will provide only a replacement water heater or part thereof. The owner is responsible for all other costs. Such costs may include but are not limited to:

a. Labor charges for service removal, repair or reinstallation of the water heater or any component part;
b. Shipping, delivery, handling, and administrative charges for forwarding the new heater or replacement part from the nearest distributor and returning the claimed defective heater or part to such distributor.
c. All cost necessary or incidental for any material and/or permits required for installation of the replacement.

5. LIMITATIONS ON IMPLIED WARRANTIES

Implied warranties, including the warranty of merchantability imposed on the sale of this heater under state law are limited to one (1) year duration for the heater or any of its parts. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

6. CLAIM PROCEDURE

Any claim under the warranty should be initiated with the dealer who sold the water heater, or with any other dealer handling the warrantor's products. If this is not practicable, the owner should contact:

U.S. Customers	Canadian Customers
A. O. Smith Corporation	A. O. Smith Enterprises Ltd.
500 Tennessee Waltz Parkway	P. O. Box, 310 - 768 Erie Street
Ashland City, TN 37015	Stratford (Ontario) N5A 6T3
Telephone: 1-(800)-323-2636	Telephone: 1-(800) 265-8520

a. The warrantor will only honor replacement with identical or similar water heater or parts thereof which are manufactured or distributed by the warrantor.
b. Dealer replacements are made subject to in-warranty validation by warrantor.

7. DISCLAIMERS

NO OTHER EXPRESS WARRANTY HAS BEEN OR WILL BE MADE IN BEHALF OF THE WARRANTOR WITH RESPECT TO THE MERCHANTABILITY OF THE HEATER OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE WATER HEATER. THE WARRANTOR SHALL NOT BE RESPONSIBLE FOR WATER DAMAGE, LOSS OF USE OF THE UNIT, INCONVENIENCE, LOSS OR DAMAGE TO PERSONAL PROPERTY OR OTHER CONSEQUENTIAL DAMAGE. THE WARRANTOR SHALL NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR DAMAGE TO ANY PERSONS OR PROPERTY, WHETHER DIRECT OR INDIRECT, AND WHETHER ARISING IN CONTRACT OR TORT.

a. Some states do not allow the exclusion or limitation of the incidental or consequential damage, so the above limitations or exclusions may not apply to you.
b. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Fill in the following for your own reference. Keep it. Registration is not a condition of warranty. The model and serial number are found on the heater's rating plate.

Date Installed_____ Model No._____ Serial No._____

Dealer's Name_____ Phone No._____

Dealer's Address_____ City and State_____ Zip Code_____

FILL IN WARRANTY AND KEEP FOR FUTURE REFERENCE.

500 Tennessee Waltz Parkway, Ashland City, TN 37015
Technical Support: 800-527-1953 • Parts: 800-433-2545 • Fax: 800-644-9306
www.hotwater.com